

# REDEFINING HOME WITH SMART HOME TECHNOLOGIES

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On my honor as a University Student, I have neither given nor received  
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## INTRODUCTION

The home is at the core of the family unit. Within the home is where life happens: meals are eaten, TV is watched, people interact and memories are formed. While family structures and values vary among cultures and generations, the human components of a family have remained fairly constant. The humans that make up a family usually consist of parents and their children and depending on the culture, the extended family may be present along with pets in the home. More recently, there have been new actors in the family space. Though not alive, these actors are active and have become central to daily life in many homes. They are smart devices: smart assistants, thermostats, doorbells, appliances and much more. The growth of smart home products has brought many benefits in the home by simplifying many tasks through automation. A study by Stojkoska and Trivodaliev (2017), which surveyed thousands of scholarly articles, showed a significant increase in academic research into smart home technologies (p. 1456). This demonstrates the increased prevalence of these devices and the ongoing work to better understand them. While many studies in the survey vary in subject matter, the majority of them investigate smart devices from an entirely technical perspective. The complex interaction between these devices and the humans that interact with them has not been thoroughly investigated, but the implications of these new interactions cannot be ignored. These devices reshape the experience in the home and introduce new questions regarding how the home is redefined by these devices. This paper seeks to determine to what extent smart home technology has impacted family dynamics in the home and how potentially harmful effects can be mitigated.

## LITERATURE REVIEW

Saizmaa and Kim's (2008) article on smart home design is foundational to understanding what a home is and how smart technologies can enter and affect a space. The article argues that most smart home research of the time focused on the technological possibilities and not on the needs of those living in the home. The authors point this out as an issue because it affects acceptance, long-term use, and consequences. They go on to state that one of the challenges of technology usage in the home is that a home includes many aspects of life from physical and psychological needs to social norms and empowerment. Thus, a purely technological approach to smart homes fails to successfully address the needs of the individuals in the home. A major point of discussion in the article was the differentiation of the home from the workplace and an emphasis on the concept of homeliness. The article concluded with two factors affecting the acceptance and attitude of smart home technology: technological characteristics and home related characteristics. This article will prove useful in understanding the core aspects of what makes a home and how smart home technologies affect the home.

Arnold's (2004) article on the connected home identifies the major changes in the home as information and communication technologies have become more ubiquitous. The article elaborates on the sociotechnical changes that occurred as the emphasis on information and communication technologies moved from the workplace to the home. Arnold argues that the transition of the information and communication technologies represents the appropriation and domestication of technologies. The article goes on to identify the difficulty researching technology in the home due to the private nature, Arnold (2004) states that "test-labs and prototypes don't interrogate the routine" (p.184). This presents an important question of how sociotechnical research can be conducted in a home setting and offers possible techniques for

determining the effect of technology in the home. A collaborative research approach is presented that works with householders to understand the effect of technologies by examining the appropriation of that technology in the home. Arnold presents a technique that he calls “Domestic Probes” that is derived from a body of work on “Cultural Probes” which invite individuals in a home to engage with artifacts. While the article does not provide a concrete implementation of the technique, it laid a foundation to empirically investigate the home which is critical to smart home device design.

Beneteau et al’s (2020) article on parenting with Alexa explores the introduction of smart speakers on family dynamics, with a particular emphasis on the parent-child relationship. Their study used an inductive approach to analyze the recordings of in-home smart speaker use. The data collected provides empirical evidence to demonstrate how smart speakers in a home can support parenting behaviors and goals. While engagement with the speaker caused occasional conflict, many parents used the speaker to better their parenting. The work found that smart speakers influenced family dynamics in three forms: augmenting parenting, fostering communication, and disrupting access. Unlike the previously mentioned study, this article used a method that engaged families and technologies within the context of their home while adding on a pre and post family interview. Though the majority of the families in the study were white, there were some Hispanic, Asian, and African American families with diverse families consisting of multiple children, languages, income levels and structures. The study has a few limitations because it was conducted over the summer when children are not in school. Additionally, the age range of the children in the study did not vary greatly. However, the study as a whole provides findings for designers to use to promote parenting and encourage communication skills.

Fritz et al's (2016) article ran a study to understand the influence of culture on the older adults' adoption of smart home monitoring. Their team conducted an interdisciplinary study on adults age 65 and older to determine their receptiveness to smart technology as well the role of artificial intelligence in sensor monitoring to maintain health and safety. In-depth email interviews were conducted on the sample group of older adults to collect data that was later processed with content analysis. Several methods were employed to collect and analyze the information from the study including the use of situated philosophy and qualitative discovery sampling to determine the participants for the study. Their results identified themes that older adults cared about including privacy, family, trust, pride, cost and several more. Based on these themes, researchers concluded that openness to smart home monitoring depended on the level to which a particular piece of technology met a need, the perceived loss of privacy, functionality and cost. One of the biggest limitations of this study was that the method of data collection over email did not enable for full expression of responses such as body language or facial expressions. Additionally, the sample size of the study was fairly small and had limited ethnic and racial diversity, making it difficult to come to conclusions about how different cultures perceived smart home technology. Overall, this study will be useful in understanding how older adults receive smart home technologies and how this may affect family dynamics within the home.

## **APPLYING ACTOR-NETWORK THEORY**

Technology plays a large part in everyday life and has been embedded into many aspects of the human experience. Many of these devices embed themselves into common spaces, especially in the home. These smart devices come in many shapes, forms, and functions. While these devices are not humans, they have been playing a real and active role in many homes and affect the members of the household in tangible ways. For this reason, Actor Network Theory

(ANT) will be used to examine the role of smart devices in a home and how they interact with the members of a household.

ANT, developed by Latour (1996) is useful for this analysis because it emphasizes the social aspects that nonhuman entities have on human entities. An actor is any source of action, whether or not it is a human, which also mean that nonhuman entities in this framework have the potential to exercise agency over human entities in a space. For this reason, ANT challenges the notion that technology is simply an outside force that acts on humans and instead suggests that technology comes out of public interest and shapes relations between people. The actors in a network play an active role and have the power to change other actors, thus they have agency. Another major component of ANT is viewing the world through networks. These networks are not limited to just humans but can include any actor including ideas and things that can act upon each other. As entities interact with each other and new connections are formed, these networks undergo translation. The utility of ANT lies in being able to draw relationships between the actors in the network. Another way of stating this is that ANT helps explore relations by mapping conceptual and material entities. In the same way, as smart devices enter the home, the dynamics in the home change in some ways that are immediately noticeable along with others ways that are not immediately noticeable. ANT will serve to draw out some of these new connections formed and how translation is occurring in the home as smart technologies are becoming more prevalent in the space.

## **DATA ANALYSIS AND DISCUSSION**

### **Defining the Home and Technology**

Before using ANT to address the network mentioned, it is important to define the home. According to Saizmaa and Kim (2008) home is different from house, meaning that it is much more than simply bricks and mortar. They state that home is where every day routines are carried out and a major site of family relations and interactions, creating a space of comfort and relaxation (p. 146). The introduction of technology into a space is challenging because the home contains so many essential components of human lives and meets so many physical and psychological needs as well being a space for social norms and values. Their study, Saizmaa and Kim demonstrate that home creates feelings of calm and rest while technologies create contrasting emotions of fear and stress, which presents a challenge in introducing smart home technologies. According to Arnold (2004) smart home devices represent “the appropriation and domestication of technology of the way affordances are exploited, neglected, and shaped in contexts of use, not just on the designer's screen” (p. 183) He states that technologies in the home help increase individual control over the home as well as freeing members of the household from certain tasks. These juxtaposing reactions pose the question of whether these technologies enrich our lives as they become more capable or if users become more engineered as the technologies become livelier.

### **Mobilization and Translation of Smart Home technology**

There are many different actors that partake in the formation of the network surrounding smart home technologies. An important component in an ANT analysis is determining how new actors are brought into a network through mobilization. In order to determine how these networks are mobilized, data was collected from product commercials, company websites, and various other sources. An ANT analysis of the data gathered will help show how major companies in the smart home space have gradually mobilized their devices into networks

involving end users' homes and families. The data collected will help present a case for how major companies mobilize their networks by aligning outside actors' interest to their own. One of the ways companies grow their network is through well targeted advertisements of their products. In order to bring other actors into their network, companies must get customers to share their vision for their products.

One of the larger players in the smart home space is Amazon Alexa. In one of their advertisements for their product, McFedries from Amazon (2019) states that "Alexa can help make your home smarter and more automated by simplifying your everyday routines." Amazon appeals to the users' desire for home to be a place of calm and rest as mentioned earlier. In this same advertisement, Amazon tries to align potential customers with their vision of what a smart home can be by presenting how different aspects of the home can benefit from Alexa. Amazon appeals to potential customers sense of security by presenting an Alexa camera as an actor in the home that will enable them to relax in confidence as the camera monitors the home. Along with a camera, Amazon presents the Alexa Guard service, which leverages their Echo smart speaker device to detect sounds such as smoke alarms and glass breaking in order to keep home safe. The language used by Amazon personifies their devices and presents them as an active member in the home that helps to protect the family. In this case, Amazon is introducing an actor that is not usually part of the home: a security guard. By appealing to potential customers' sense of security, Amazon can align interests to their own and mobilize new customers into their network. Another way Amazon has mobilized their network is by leveraging Alexa to bring other devices into the home.

Amazon designed Alexa as a smart assistant that can be integrated into many devices including speakers, cameras, TVs, LEDs, smart plugs, thermostats and many more. Once a

customer has one Alexa device, they open their home to many more devices that can integrate into their life. As Amazon creates "smart" versions of everyday house items, its network undergoes translation and the connections between the humans in the network are affected. Situations where family members needed to have direct interactions such as asking someone to change the temperature or check who rang the doorbell are now mediated through technology instead. As a result, it can be argued that smart home technologies are reducing human to human interactions in the home. This point of view also needs to be balanced with the promise that many smart home companies make their devices free users to have more time for life and family. In either scenario, the addition of a smart device to any network with a family brings along additional interactions that can take away from familial interactions. Thus, increasing the amount smart devices in a home can reduce the familial interactions in a home. Some companies like Google and Samsung have taken similar approaches to Amazon to building their network by creating a large ecosystem of their own products while other have focused on a few devices.

One such company in the smart home space is iRobot, a company that builds robots for home automation. The company is particularly well known for their robotic vacuum: Rumba. Similar to Amazon, iRobot's vision for a smart home involves facilitating ease and rest in the home. Their company mission as stated on their website is "building products with new levels of intelligence that fit seamlessly into your life, so you can rest easy knowing your home is covered," which is a core desire for the home as presented by Saizmaa and Kim (2008) earlier on in the paper. iRobot goes on to bolster their attempts to align customers with their vision by appealing directly to their robots' ability to assist in managing a busy life by checking cleaning tasks of a user's to-do list and fitting into their everyday schedule. While Amazon's security appeal introduced a security guard actor not present in most homes, iRobot's Rumba introduces

an actor that augments a common actor in most homes: the vacuum. The automation of the everyday task of vacuuming has several implications on family dynamics by changing the division of labor in the home. The Rumba augments discussions in a home about cleaning and can affect how responsibility is perceived in a home. According to Loderup et al, household chores during adolescence has positive long-term effects on how children perceive work and independence. While devices like the Rumba can free the human members of a household from chores, they can also result in missed opportunities to instill core values in children in the home. Thus, parents will need to find new ways of instilling similar values in their children if they choose to have chores in the home replaced by smart devices. Though the smart devices mentioned thus far are not designed with the intention of directly affecting child development, there are some designed with this in mind.

Different companies have designed smart toys to aid in adolescent development. These smart toys augment the parent-child relationship by introducing a third party to the relationship. Wonder Workshop is a company which develops robots that are as their website states, "Designed for learning, engineered for fun" for children of all ages to engage in hands on play. In their advertisement for one of their products called Dash, Wonder Workshop present the robot as "more than an engaging personality." Again, this company personifies its products in an effort to create a personal connection to its devices that would align potential customers with their interest and draw them into their network. Spot in particular appeals to parents' desire to prepare their kids for the future by teaching them practical engineering tools. Similar to the smart vacuum, the smart toys like Spot come with challenges to consider because they are a non-human engaging in a role previously held by only other humans. Wiederhold (2018) highlights this challenge in his study on the role of artificial intelligence in child development. He raises the question of whether

smart devices prevent children from learning to deal with discomfort by giving them their request immediately thus granting them instant gratification. While this has a potential to negatively affect development, it can be mitigated by increased involvement by the parents in setting healthy technological habits.

### **Applying Mediation Theory**

The home is no longer filled with simply human-human interactions but now there are more human-nonhuman interactions. Humans and smart devices in the home are not simply existing in the same space but they are mutually shaping each other in the relations between themselves. Smart home technologies not only enact relations of humans but they also affect how humans interact with each other. These devices are active mediators designed with intentions that affect the reality of a family in a home. Mediation theory, according to Verbeek (2015) provides another useful framework for analyzing the ethical implication of these technologies on the family in the home. In general, smart devices are viewed as benign artifacts in the home that can bring convenience to everyday tasks from vacuuming to temperature to remembering tasks. As smart technologies become more ubiquitous in the home, the number of human-nonhuman interactions increases which can have an effect on the human-human interactions as well as raise concerns about privacy. Mediation theory will facilitate ethical reflections regarding how smart technologies affect these interactions in the home.

With the growing number of smart devices in a home, the number of sensors that families invite into their space also increases. This raises concerns about privacy in the home as well as questions about what can be heard or seen within a home and who should have access to that information. There are many stakeholders present in answering these questions and addressing these concerns from family members to designers to government regulations. Often companies

can attempt to channel their ethical values through the networks they are developing with their products and customers. Instead of simply viewing these as privacy concerns and assuming privacy to be an accepted universal value, smart home technologies can mediate new values that redefine privacy within the home. As concerns increase about previously private spaces potentially being opened up by smart technologies, conversations need to be had between family members using the technologies and designers about how the technologies should operate in those spaces. Instead of simply focusing on improving the underlying technologies to address privacy concerns such as mute buttons on mics or lens covers on cameras in the home, the human subjects interacting with the smart devices need to be involved. As questions are answered about the interpretation of smart devices, new procedures and actions can follow that will allow family members to fully utilize the devices under renewed definitions of privacy within the home.

The users of smart technologies and the designers understand the importance of the shared responsibility in addressing the issues brought by these technologies such as privacy. The solution cannot be to simply fix it through technical means or to even project objective values about privacy or any other unit of moral action. Instead, the solution involves situational ethical analysis through which engineers and users of smart technologies build desirable values and designers actively design mediation to affect users' reactions, decisions, practices and reality.

## **CONCLUSION**

Smart home technologies have great potential to transform the concept of home and help redefine some of the core components. By using ANT and mediation theory to understand the role these technologies play in the house, designers and users can better incorporate them into their spaces. Companies that produce these technologies are constantly trying to mobilize their

products and vision into larger networks involving families and homes. They achieve this mobilization by appealing to the aspects of home that make it feel safe, secure, and restful in an effort to align the interests of potential customers their own. In doing this, companies also channel their ethical values such as privacy about technologies through their network. With the increase of non-human actors in the home comes an increase in human-nonhuman interactions as well. These interactions can often detract from the human-human connections in the home as seen in some of the child development interactions discussed. As these technologies become more commonplace the negative effects on family dynamics will need to be mitigated by first identifying the connections present in the actors at home and addressing points of difficulty. Without directly addressing these effects, smart home technologies have the potential to reduce the quality of family interactions and weaken the bonds in a home. On the other hand, if designers, parents, policy makers and other stakeholders in the network identify and address these issues, smart home technologies can be leveraged to enhance family bonds by freeing time and space for families to spend more intentional time together. Future work needs to be done to address more specific techniques for deepening family connections as technology may reduce the necessity for face-to-face interactions. Done well, smart technologies can enhance the home and continue to make it a place where life takes place for many families.

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