How smart is the Italian domestic environment? A quantitative study

Vacanti, Annapaola

Università Iuav di Venezia, Venice, Italy
avacanti@iuav.it

The market for smart home products in Italy appears to be growing quicker than in other European countries. Continuous technological advances have lowered the price for entry products, allowing more families to acquire smart solutions. Meanwhile, after the Covid-19 pandemic, the importance of the domestic environment as a hybrid space where to conduct different activities that require smart and connected appliances has significantly grown. Ultimately, economic and social instability has produced a higher awareness of energy consumption, bringing many users to question their lifestyle choices and look for smarter and greener solutions. The evolution of living conditions through the growth of smart technology in houses and apartments must be explored by interaction designers, to provide effective user experiences of smart artifacts, that need to seamlessly connect with one another and function together, within a complex, multimodal environment. Considering this, the paper presents the results of a quantitative study carried out at the end of 2021, through an online survey that was completed by 135 respondents. Data are analysed by grouping the respondents in 3 categories: single tenants, couples or roommates (unrelated to each other), and families (at least one parent with their offspring). Different visualizations highlight which rooms are "smarter" – although Italian households appear to be less technological than expected. The main findings concern the relationship between wider technological ecosystems and larger groups of tenants living together, and how the ownership of a smart product leads to the acquisition of other products – thus building a complex network of non-human players.

Keywords: human technology interaction; smart home; non-human players; survey

1   The invisible network of connected tech

Before the user was placed at the center of the Human – Machine system, Interaction Design was tasked with facilitating the proper operation of technology. In this context, the human being was considered another resource to be optimized so that the goals of the operation could be achieved (Noyes, 2002). Although interfaces and input modes were designed from the users' point of view, the designers determined precisely what actions the users needed to perform, outlining the "right way" to use the system so that the machine would operate effectively and accurately. The Human Centered

Design (HCD) approach has challenged these design methods, focusing on the added value that technology brings to users' daily lives; technology should not exist for its own sake, but to improve people's quality of life (Krippendorff, 2004). Therefore, the physical context of use, as well as the psychological and social context, must be taken in consideration (Leikas, 2009). In short, the HCD approach places an immediate focus on users and their needs, which must be fulfilled through the artifact in question: in addition to identifying and classifying users (actual and potential), it is important to take a well-structured approach to evaluating and measuring how the project is being used; use cases must be defined by placing emphasis on users' behavior, considering their unique capabilities and their ease of learning (Rubin & Chisnell, 2008).

Today, the paradigm towards which the discipline is moving is increasingly characterized by a multidimensional and holistic approach, justified by the systematic spread of digital solutions in our lives. In the contemporary Hybrid Age (Khanna & Khanna, 2013), technology is ubiquitous (our environment is lined with sensors), intelligent (devices can communicate with us and with each other), and social (we are encouraged to develop emotional relationships with synthetic artifacts). Such concepts are summarized by Kelly in the idea of the Technium (2011), an immense global system of interconnected technologies, a kind of superorganism of our own creation, in which we are unknowingly immersed.

For these reasons, the study of Human – Technology Interaction requires the exploration of the activity of a cooperative system, which users and technology form together with their physical and social environment (Norros et al., 2003). This focus on context and relationships is made necessary by the evolution of ICT technologies, which, departing from the early stages of development, consist of products and services increasingly endowed with a degree of intelligence describable as the ability to interact not only with the user, but also with other smart artifacts, providing optimized responses and solutions depending on the situation and operating in synergy (Diana, 2021). In addition, while an increasing number of daily actions are performed with the help of different technological systems, the same devices can have multiple purposes and be used differently by different users, if not even by the same user, depending on the goal he or she wants to accomplish (Leikas, 2009).

1.1 The domestic environment

The domestic environment, due to its great importance in our everyday lives and to the variability of activities which take place within it, poses complex interaction challenges. The term Smart Home refers to convenient setups where different devices are remotely controlled through Internet connection. Nowadays, the market for smart products can be categorized as follows:

- Voice assistants and smart speakers;
- Smart appliances such as refrigerators or ovens;
- Small robots such as vacuum cleaners and microwave ovens;
- Connectivity tools such as smart plugs;
- Security tools such as cameras or sensors;
- Home Entertainment products such as smart TVs and speakers;
- Lighting products such as smart lamps and bulbs;
- Energy management appliances such as smart thermostats.

Smart appliances may perform tasks automatically and/or be activated/deactivated from anywhere through direct human input. Wireless systems have made such solutions available to a wider public, due to their affordability when compared with hardwired systems, which in turn are often considered more reliable and can enhance the resale value of an apartment/house. All the appliances being connected to the same Wi-Fi concur to generate an invisible network that works in concert and surrounds the users. Using network science terminology (Barabasi, 2003), each artifact represents a node, which goes to connect with the other artifacts (or users) with which it interacts.

A set of voice-activated smart bulbs is then connected directly with the voice assistant (e.g., Alexa), which is in turn connected with the node representing the main user of the system and secondary users (spouse, children, guests, ...). The smartphone can be considered a hub because of the very large number of connections it weaves with other nodes; in fact, from being an indispensable device in the lives of almost all people, it has now turned into an interface for interacting with countless other devices. Finally, many of these nodes, especially those referring to artifacts endowed with autonomous movement, can come into interaction with nonhuman users: cats seem to find it particularly fun to travel around the house sitting on top of robot vacuum cleaners, whose flat shape (designed to facilitate passage under low furniture) is particularly comfortable for them. Some pets, however, become terribly frightened when seeing an unfamiliar device move or hearing it speak.

It is clear from these trivial examples that the user is not alone but, although his or her needs remain central, is surrounded by a system of human, animal, and artificial actors (Van Mensvoort, 2022). This makes interaction problems increasingly complex to address, in particular where technology is integrated within artifacts without an adequate feedback design capable of informing the user of the state of the system. Also, designing smart home technology often requires designing for retrofitting (Diana, 2021), by inserting new functionality within an existing system. This concept is key in developing smart solutions that can talk to each other. It is easier for the user to accept an innovation that fits easily within their network, controllable through devices they already own, such as a computer, smartphone, voice assistant, or smart watch. The challenges involved require a holistic consideration based on human values that direct the design of technology in an inclusive manner. While the starting point of design must always be the context of people's lives, it must be studied by avoiding oversimplification, but rather by exploring all the elements surrounding Human – Machine Interaction.

2 The Italian market of smart homes

90% of Italians put living conditions at home at the top of their list of priorities (Centro Studi TIM, 2021), due to a multiplicity of meanings that such a place holds, which go far beyond the idea of a physical asset with economic value; one's home has existential value, and it is perceived as a place of affection and personal expression. According to reports (ibidem, 2021) 48% of Italian citizens is not completely satisfied with their home conditions; such percentage grows higher among millennials, and even more so among those who live in apartments compared to those who live in independent houses. There is a growing desire to live in more energy-efficient and smart homes, resulting in environmental, economic, and wellbeing benefits. The lockdown in 2020 accelerated the necessity to renovate and improve technological endowments, while Internet connection is considered to be a fundamental and indispensable element for a satisfactory living condition.

According to a European Commission report (2019), before the Covid-19 pandemic Italian homes were less smart than the European average: in Italy there were 6 smart objects for every 10 homes, in the United Kingdom 18 for every 10 homes, in Germany 16, in France 12. During 2020, which was heavily marked by the impact of the health crisis, the smart home market declined slightly, standing at a total value of about 566 million euros. However, voice assistants and smart appliances – which are the dominant players in the market, for which they account for a share of more than 30% – registered significant unstoppable growth (Centro Studi TIM, 2021).

For a consumer who is purchasing his or her first smart product, punctual solutions seem to be preferable to smart kits, that were popular a few years ago, especially in the United States, where the smart home market developed earlier than in Europe and Italy. In fact, voice assistants – which have been on the U.S. market since 2014 – often function as integrators (i.e., hubs) of different devices, through voice commands and related mobile applications. Other popular punctual solutions include smart bulbs, thermostats, smart plugs, and cameras; kits remain highly popular with regard to security tools, where reliability is prioritized. Compared to complete home automation systems, punctual solutions generated 67% of combined market revenues in North America and Europe (ibidem, 2021).

These data can be integrated with a more recent report released in 2023 by the Internet of Things Observatory of the School of Management of Politecnico di Milano. In 2022, the market has significantly grown: +18% compared to the previous year, reaching a value of 770 million euros. This is a higher growth rate than that of other European countries, such as that recorded in Spain (+10%, 530 million euros), the United Kingdom (4 billion euros, +4.1%) and France (1.3 billion, +2%), while Germany (-5%, 3.7 billion) is in decline. According to the report (ibidem, 2023), the market growth has been held back by semiconductor and raw material shortages due to international economic and political instability. However, the rising cost of energy has prompted Italians to pay more attention to energy conservation: the Italian market is currently led by connected boilers, thermostats, and air conditioners for heating and air conditioning (155 million), followed by security solutions (150 million), connected home appliances (140 million), and voice assistants (137 million), as well as light bulbs, audio speakers, smart plugs, and devices to manage blinds and shutters remotely. The sector of smart appliances has seen a progressive expansion of supply, while voice assistants have experienced a slowdown in the growth trend, due in large part to the gradual saturation of the market, with more and more homes already having one or more products.

Ultimately, it must be noticed that effective usage of smart solutions is growing. Most Italian consumers who own smart objects affirm to frequently use their features (63%) (ibidem, 2023). Mobile apps are the main interface (72%) and the number of consumers able to independently activate apps associated with smart objects is growing (78% of respondents). Smart home management remains a fairly fragmented experience for the user, but improvements are noticeable: 34% of Italians use a single app to manage multiple devices, in most cases designed from the same brand (22%).

3   Methodology and sample analysis

Considering the hereby depicted scenario, this study aims to explore more deeply the living conditions in Italian homes, understanding not only what smart devices are in use, but how they are related to each other and to the actors (human and non-human) who inhabit the place. To gain deeper

knowledge about such themes, data are collected and analyzed in order to identify the "smarter" rooms within a household and define the maximum and minimum smart ecosystems of connected devices.

Quantitative research has been conducted in December 2021, in the form of an online survey, designed with Tripetto (http://tripetto.app). This freely available tool allows to create aesthetically pleasing and user-friendly interfaces, which can reproduce a simple mobile chat (fig. 1), allowing participants to answer quickly to questions and reduce the risk of abandonment of the survey (Pettit, 2016). The questions are organized as follows:

- Demographics of the participant (age, education);
- Living conditions (apartment or independent house, type of Internet connection);
- Familiar context (number of people living together, relationships, presence of pets);
- General smart products (smartphone, laptop, computer, wearables, …);
- Smart devices in each room (kitchen, toilet, living room, bedroom, other).
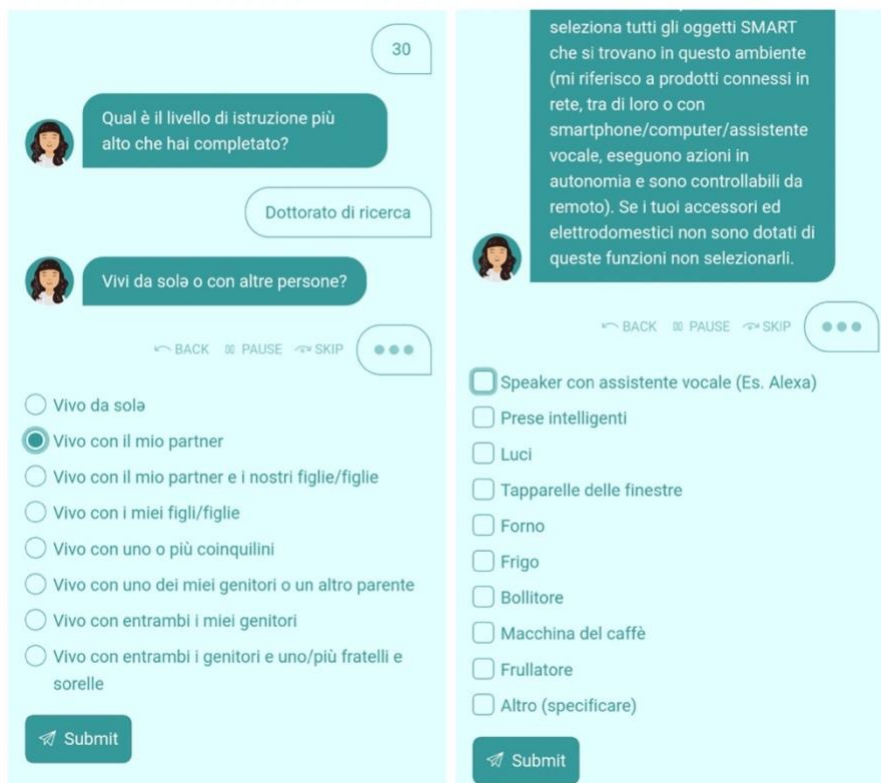

Figure 1. The user interface of the survey, designed with Tripetto online tool. The survey was submitted in Italian to facilitate respondents. The screenshots in this figure show questions about the familiar context (on the left) and the smart environment of the kitchen (on the right).

The survey has been completed by 135 Italian citizens. It follows a brief analysis of the sample, useful to interpret the following section, which presents the results of the study through different visual explorations of the data.

The participants represent a quite homogeneous sample in terms of age (which ranges from 22 to 50 years old) and education level (87% holds at least a bachelor's degree; 64% holds a master's degree

or a Ph.D.). The sample thus includes young adults with average spending capacity, and most likely aware of technological development, who may be more attracted than other customers by the purchase of smart home devices.

21% of the households considered host single tenants, while 44% host couples or roommates (unrelated to each other). 47% of the households are occupied by families consisting of at least one parent with their offspring (most families consist of 3 or 4 people at most). While 76% of singles do not own any pets, 42% of couples and 49% of families live with at least one animal. Those who own a dog tend to have no other animals, while many of the cat owners have at least two in their homes; this condition makes cats the prevalent animal species in Italian homes, closely followed by dogs, while just 3 respondents declared to own birds, fishes, or reptiles.

Most of the participants declared to live in condominium apartments (86%), while only 19 respondents declared to live in an independent house. A very small variation was shown between the type and number of smart items in the two types of housing. Finally, 90% of the homes considered are provided with Internet connection through a subscription and are equipped with wi-fi network. The remaining 10% are connected to the net through mobile network.

4   Results

4.1   Basic technologic equipment
During the survey, participants were asked to declare which of the indicated technological devices (or others, if any) were in their homes. Only artifacts capable of connecting to the network and performing actions autonomously or through direct or indirect input (e.g., appliances controllable by smartphone or voice assistant) from the user were considered. The first part of the survey focused on personal devices not specifically aimed at being used within the home environment, such as laptops, desktop computers, and wearable accessories. The use of these types of devices in the home facilitates interaction with other technologies, since many of them serve the function of interfaces for managing home automation furnishings. Participants in the study indicated the presence of the aforementioned devices within their homes, even if they belonged to other tenants.

First of all, it is worth noticing – although unsurprising – that at least one smartphone and one laptop computer were reported in 100% of the households, while only in 38 of them (28%) there is a desktop computer. A tablet is found in 64% of the homes, but only in 39% of them is an e-book reader. As for wearable devices, the smart watch (44% of respondents) is more widely used than the fitness band (27%); the latter, in fact, offers fewer different functionalities, which instead come together within a single product in the case of the smart watch. More than half of the respondents (54%), on the other hand, reported using wireless headphones. There does not appear to be a substantial difference between the adoption of these devices within homes inhabited by singles, couples and roommates, or families, with the exception of the tablet, which is used mostly by families (87%, versus 48% of singles and 53% of couples).

4.2   Smart devices and appliances
Regarding robotic tools, 31% of homes are equipped with robot vacuum cleaners. This type of device is predominant in homes where couples or roommates live (42% versus 14% of singles and 28% of families). Other types of robots are very little used, with only 2 participants reporting the use of

telepresence robots and 5 (including 4 living in independent houses) owning a toy robot. A voice assistant is present in 40% of the households. In singles' dwellings it is used more often than in other contexts (48%). These devices are usually found in the kitchen or living room, more rarely in the bedroom and only in a few cases in the bathroom. Sockets and smart lights are not very common (16% and 22%, respectively), but there is a close relationship between their presence and that of the voice assistant.

The absolute most popular smart device is the television, present in more than half of homes (52%) with a surge in homes inhabited by families (62%) and worse results for singles (34%). In addition, several homes are equipped with smart speakers to play music (26%), while 16% are equipped with smart thermostats. There is also a small presence of smart bedside lamps (12%). Below these percentages settle most of the devices dedicated to the kitchen and bathroom, such as oven (5%), refrigerator (6%), kettle (6%), coffee maker (7%), food processor (2%), and shower (5%) and sink (5%) mixers. More invasive solutions from the point of view of installation such as automatic shutters are also quite rare (7%).

Considering the type of tenants in relation to the type of devices, we see that the ecosystem where single people live is less technological than the others. In homes inhabited by couples or roommates, a greater presence of robot vacuum cleaners (42%) and smart lights (32%) stands out, while homes inhabited by families more often contain a desktop computer (45%) and kitchen devices.

The main configurations organized by tenant type are graphically described in the data visualizations that follow (fig. 2, 3, 4). The visualizations show which of the twenty-eight technological devices considered are present in Italian homes, in relation to the type of tenants living there. The gray area with which each node in the visualization is identified indicates in what percentage of homes each product can be found. In addition, each ecosystem of items that was collected in the questionnaire is depicted by linking the nodes together and creating at-a-glance areas of greatest concentration that highlight the most typical configurations; the black dashed line indicates the most common.

Fig. 2 illustrates which smart products are most often in use within houses and apartments inhabited by only one tenant. Such environments are often less populated than those of couples and families. In general, this user type seems to be more interested in personal technological products such as laptops, tablets, and wearables (smart watches and wireless earplugs in particular); it may be argued that a person who lives alone perceives a lower necessity of being in full control of his or her environment and prefers to manage his or her activities autonomously. The most used smart devices used by single tenants are smart TVs and voice assistants; the latter are owned more often by single tenants than by other user types.
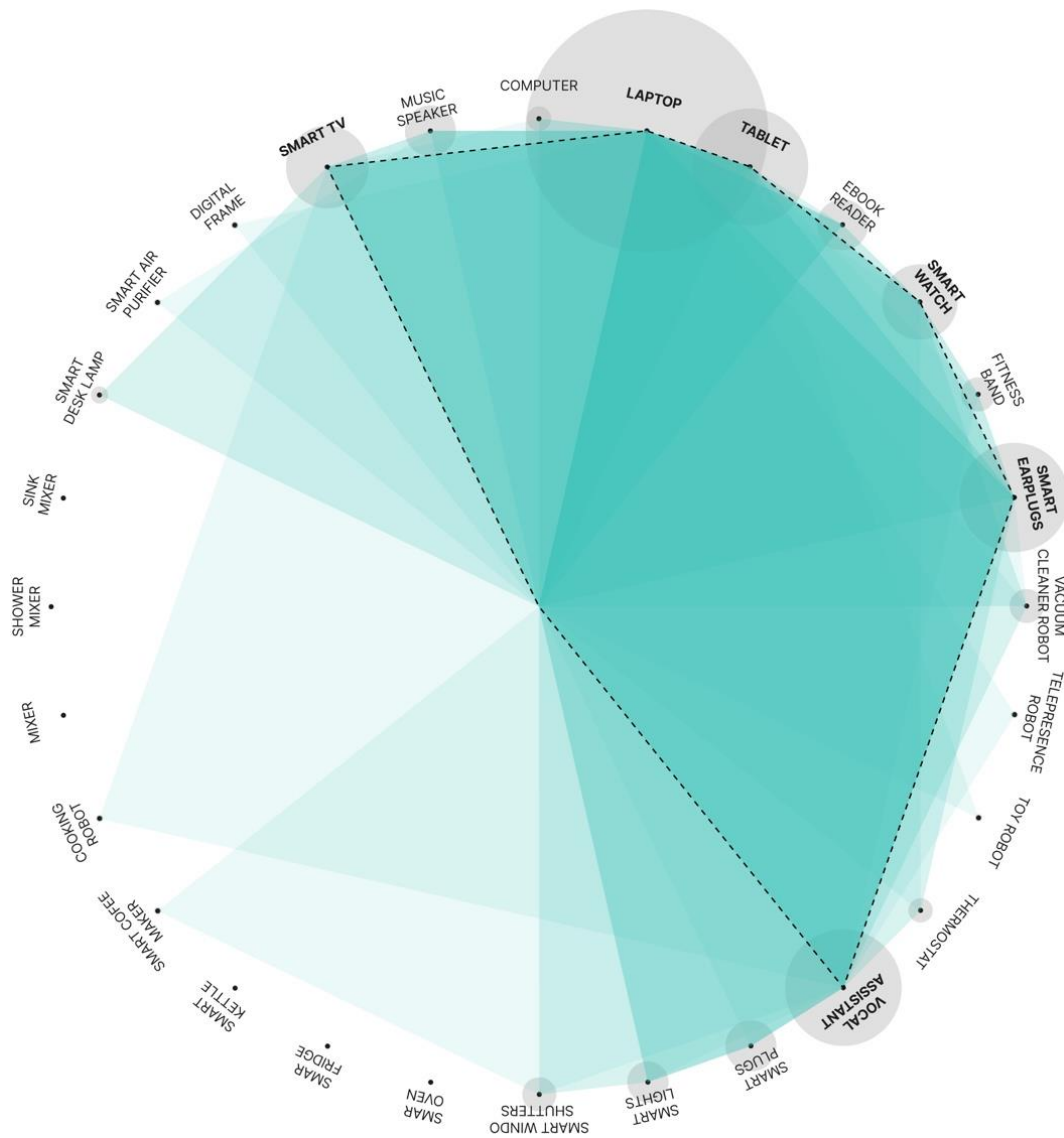
Figure 2. A visualization of the smart ecosystem in the homes of single people.

Fig. 3 illustrates which smart products may be found in the households of couples and roommates. These two categories have been considered together to distinguish them from family units formed by sons and daughters living with at least one parent. Such categorization must be considered merely instrumental for the research and has been selected only to group similar domestic conditions. Couples and roommates present similarities with regard to the fact that they indicate two or more adults living together without a condition of responsibility to children or – conversely – to aging parents.

This user type tends to inhabit a smarter environment than single tenants, where a smart TV and a voice assistant are often present, along with vacuum cleaner robots and smart lights. It may be considered that these users look for high efficiency within their homes, selecting affordable but effective solutions to autonomously manage them.
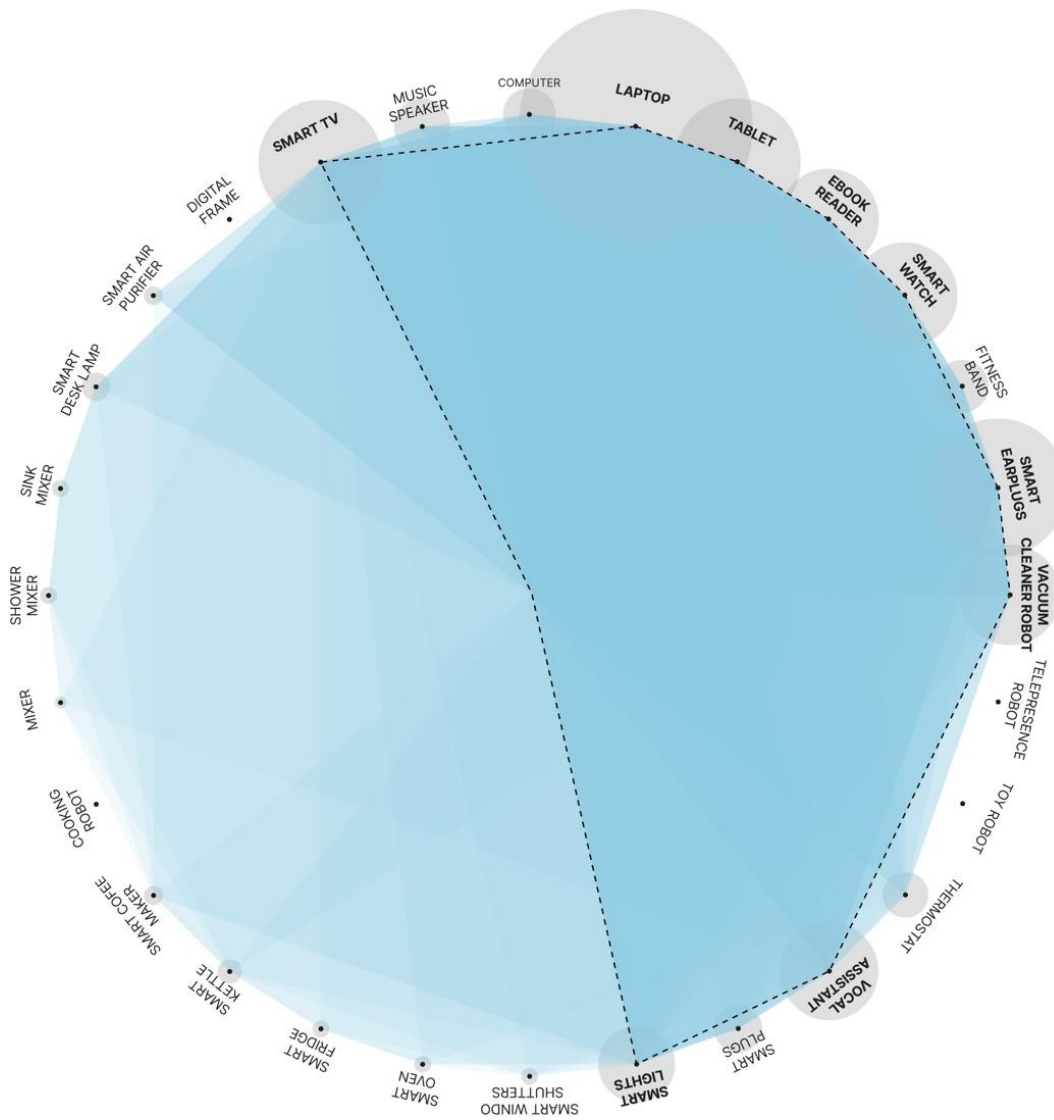
Figure 3. A visualization of the smart ecosystem in the homes of couples and roommates.

Fig. 4 illustrates which smart products are in use in the households inhabited by families (at least one parents with sons and/or daughters). This user type seems to be particularly interested in the entertainment sector of the smart home market, purchasing smart TVs along with desktop computers, tablets, e-book readers, and music speakers. The voice assistant is widely used in these households as well.

Finally, fig. 5 provides a summary of the data showcased in previous figures, to make it easier to compare them, the last data point regards the presence of animals. It is quite evident how the smart environment of single tenants is smaller than the other two, with families being more interested in kitchen and entertainment smart products.
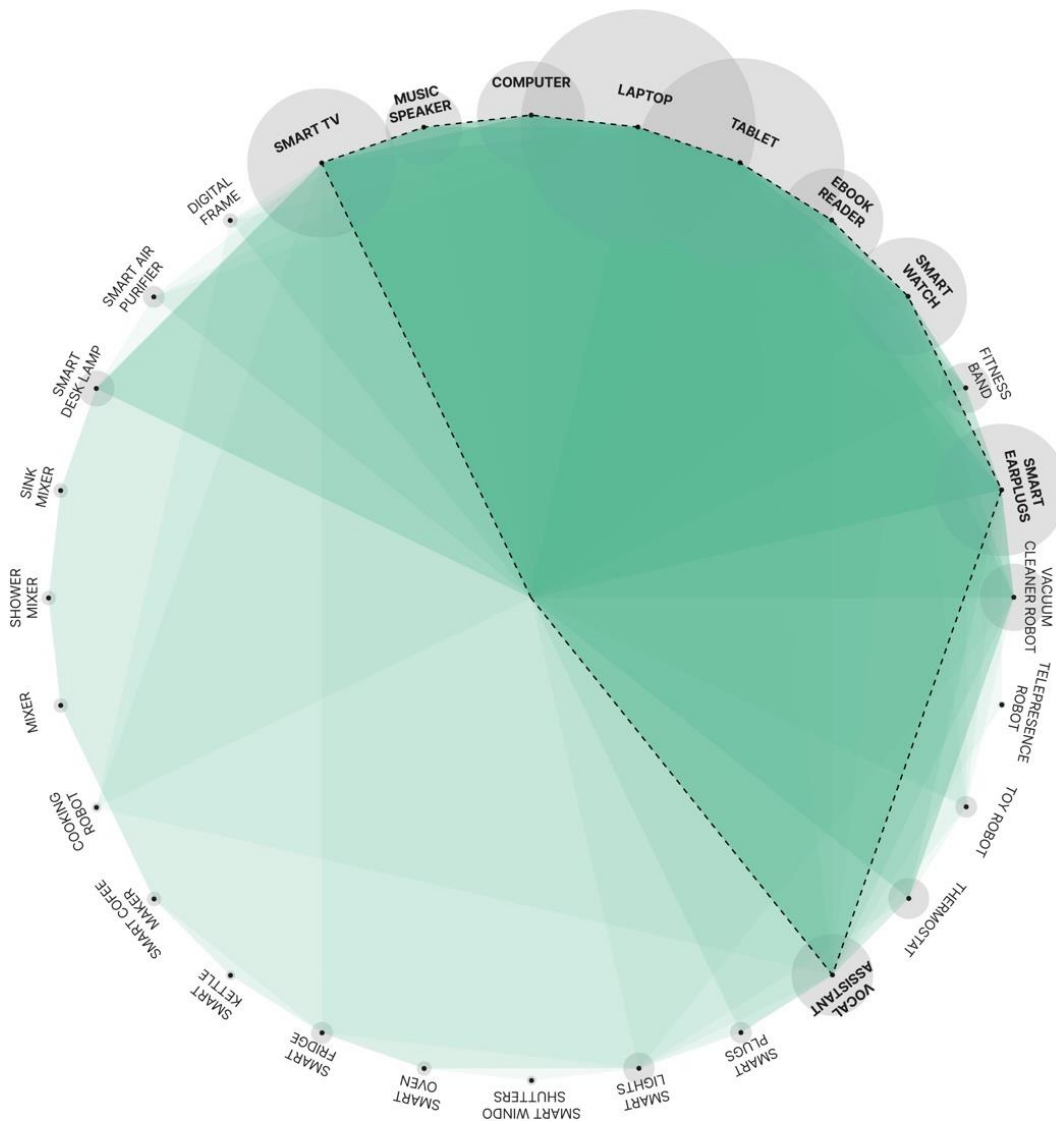
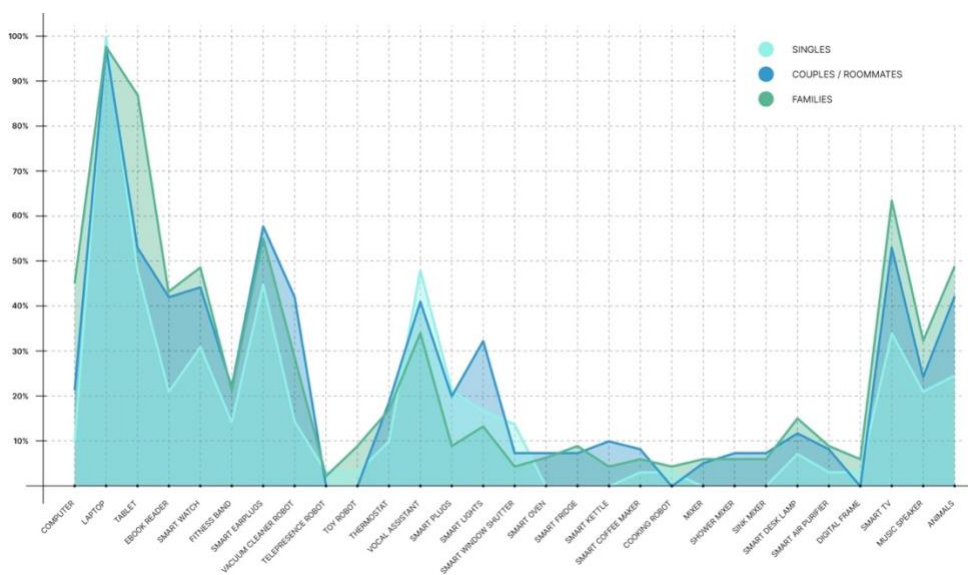*Figure 4. A visualization of the smart ecosystem in the homes of families.*

Figure 5. A comparison of the smart ecosystems of households inhabited by singles, couples/roommates, and families.

4.3 Smaller and larger ecosystems

The minimum ecosystem is recorded by a 29-year-old woman who lives alone in a condominium apartment, without any pets. The only technological devices she owns are her smartphone and laptop computer, but she still holds a subscription with wi-fi connection.

The larger smart ecosystem is recorded by a 28-year-old man living in an apartment with one roommate, and with no pets. His network of devices includes desktop and laptop computers, smartphones, tablets, e-book reader, smart watch, fitness band, headphones, robot vacuum cleaner, voice assistant, thermostat, lights, air purifier, and smart TV.

4.4 Distribution of technology between rooms

At this point, it is useful to analyze the data for the individual rooms, to understand which of them are more technology-rich, and which products are actually being used (fig. 6). For this purpose, computers, smartphones, wearable accessories, and robots were not taken into account, as none of these items have a defined location within a prearranged space (with the exception of desktop computers; however, as we have seen, they are present in Italians' homes in a not particularly relevant percentage).

First of all, note that as many as 24% of respondents reported that they do not own any smart technology devices (eliminating those mentioned above). Among the homes of those who responded positively, the "most technological" room is definitely the living room (69% of homes surveyed); followed by the bedroom (44%) and the kitchen (36%). In contrast, only 18% of bathrooms are equipped with smart solutions. These percentages alone, however, are not enough to clarify which products are actually present in the different rooms.

A smart TV is found in 72% of smart living rooms (i.e., equipped with at least one device), while voice assistant and music speakers are present in 40% of them. Around 20% settles the presence of smart plugs and smart lights. The presence of automatic blinds, air purifiers and digital picture frames is not very common. In smart bedrooms we find voice assistants and lights (40% and 42% respectively), more rarely a smart TV (38%), plugs (24%) and smart bedside lamps (27%).

The kitchen is the room where a voice assistant is most often found (71%), along with lights (43%) and sockets (29%). It should be noted that products expressly dedicated to this space are very little used (ovens, fridges, kettles, coffee makers, and smart blenders are all found in less than 20% of smart kitchens). Similarly, 50% of the few smart bathrooms contain smart lights, but only 29% of these are equipped with smart showers or sink mixers. The bathroom is also the room in which the voice assistant is most rarely used (33%).
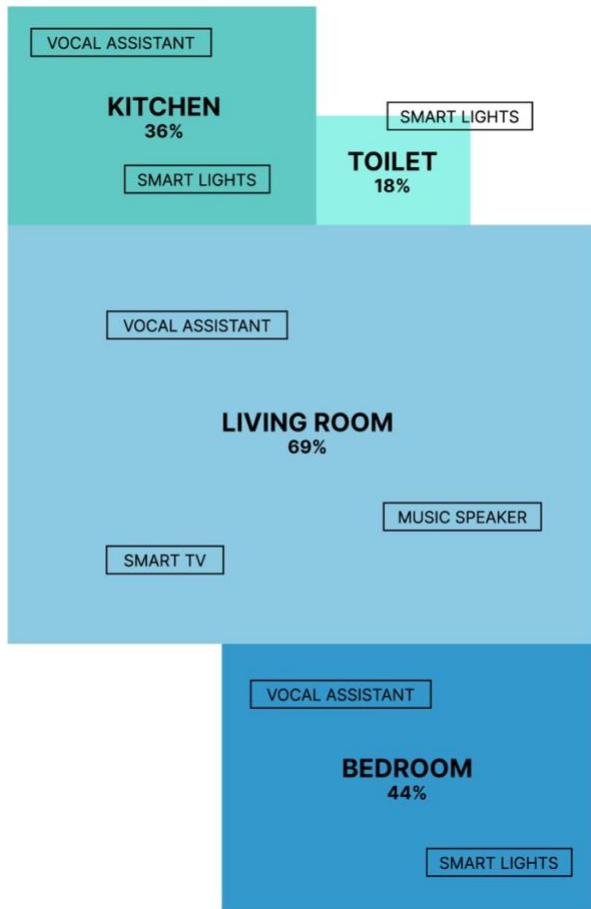
Figure 6. A visual representation of the presence of technology within each room.

5 Conclusions

5.1 Discussion

The results of the quantitative study depict a scenario where smart home devices have not yet been fully introduced within Italian households. 24% of the participants do not own any smart product specific for the domestic environment. Most respondents live in condominium apartments (86%) rather than independent houses: this condition makes it easier for wireless smart products to be successful, in comparison with hardwired systems that require massive renovating actions to be installed. Such a scenario differentiates the Italian smart home from the U.S. one: the American market of smart products developed quite early, when kits and systemic solutions were spreading: instead, Italians prefer to buy punctual solutions (Centro Studi TIM, 2021).

The survey confirms a positive trend for voice assistants, which are quite widespread (40% of households). Being integrators for other devices, these products are likely to be the first smart home purchase for many people, leading to a progressive increase in the smartness of Italian homes. In this case, the role of Interaction Design is pivotal to improve the overall experience of living in a smart home, as for now different devices tend to be designed overlooking the interaction among each other: a more seamless experience and higher degree of communication between devices is requested by

36% of the users (Osservatorio Internet of Things, 2023). At the same time, Italian users are reaching a good level of maturity in using smart products and their related apps: 78% of them can activate smart features autonomously (ibidem, 2023). For designers it is then necessary to deepen the understanding of the overall environment in which a new artifact may be introduced, and what elements may represent obstacles to the choice of buying smart tech.

According to the survey, single tenants tend to go without smart domestic appliances. Also, they have less pets (24%), which makes sense if we consider the challenge of taking care of an animal alone, while having many other daily commitments. It may be argued that they are less inclined than other people to spend a large amount of money (and alone time) in their houses. Such considerations on this buyer segment may lead to focus on cheap products designed to make the management of the domestic environment efficient and practical.

Households inhabited by more than one tenant tend to have wider technological ecosystems; at the same time, more than 40% of people living together also share their domestic space with at least one pet. Slight differences may be found among couples/roommates and families: the first group appears to be more interested in making the house efficient with products that support daily activities such as vacuum cleaners, smart lights, and plugs. The second group, while interested in such products, is more willing to spend money on entertainment products such as smart TVs and speakers. This suggests that families enjoy staying at home together more, which makes this scenario the most challenging for Interaction Design: several users of different ages interact with the same device, which in turn should be as efficient as possible in interacting with other devices. Great care should be put in the design of UI/UX for mobile apps managing different products, so that they are easy to use for different age ranges; also, products need to be safe for younger and older tenants and designed to interfere as little as possible with the activities of pets (especially cats) that share the same environment – let us point out that the smarter rooms are in fact living rooms (69%), where typically animals tend to hang out. On the other hand, technology may allow for deeper interaction with domestic animals, and creating new and funny ways to take care of them (Chan, 2023).

5.2   Further developments

In conclusion, the insights collected in this research activity show how challenging it will be for designers to create effective and positive interaction among human, animal, and technological entities, as domestic environments quickly grow smarter and smarter. There are some limits to this survey that must be acknowledged and will be tackled in future developments of the research. Firstly, a qualitative evaluation of the satisfaction of Italian users with their smart devices and appliances is missing and may be obtained through qualitative methods such as interviews, that should also involve a wider age range, in order to gain more perspective on different living conditions. Second, a bigger focus should be put on domestic animals interacting with technology, which may be done through contextual observation or simulation activities. Such data, together with what already collected, will aim to provide pragmatic guidance and understanding for interaction designers to gain the systemic vision required to work within the complexity of domestic relationships.

References

Barabási, A. L. (2003). Linked: The new science of networks.

Centro Studi TIM (2021). RAPPORTO SMART HOME. Internet of Things nelle case italiane. Roma. Available at: https://www.gruppotim.it/content/dam/gt/gruppo/documenti/RapportoSmartHomeCentroStudiTIM23032021.pdf

Chan, T. (2023). The 10 Pet Tech Products You Should Be Adding to Your Home. Rolling Stone. https://www.rollingstone.com/product-recommendations/electronics/best-smart-pet-tech-products-1234679089/

Diana, C. (2021). My robot gets me: How social design can make new products more human. Harvard Business School Press.

European Commission (2019). Smart home and appliances: state of the art. Energy, communications, protocols, standards. Publications Office. Available at: https://data.europa.eu/doi/10.2760/453301

Kelly, K. (2010). What technology wants. Penguin.

Khanna, A., Khanna, P. (2013). Hybrid reality: Thriving in the emerging human-technology civilization. TED Books.

Krippendorff, K. (2004). Intrinsic motivation and human-centred design. Theoretical Issues in Ergonomics Science, 5(1), 43-72.

Leikas, J. (2009). Life-based design: a holistic approach to designing human-technology interaction. VTT Technical Research Centre of Finland.

Norros, L., Kaasinen, E., Plomp, J., & Rämä, P. (2003). Human-technology interaction research and design: VTT roadmap.

Noyes, J. (2002). Designing for humans. Psychology Press.

Osservatorio Internet of Things (2023). Smart Home, è ora di innovare: focus su energia ed ecosistemi. Report 2022-2023, School of Management, Politecnico di Milano. Available at: https://www.osservatori.net/it/prodotti/formato/report/smart-home-ora-di-innovare-focus-energia-ecosistemi-report

Pettit, F. A. (2016). People Aren't Robots: A practical guide to the psychology and technique of questionnaire design. CreateSpace Independent Publishing Platform.

Rubin, J., Chisnell, D. (2008). Handbook of usability testing: how to plan, design and conduct effective tests. John Wiley & Sons, New York.

Vacanti, A. (2023). Dataset for «How smart is the Italian domestic environment? A quantitative study» article. https://doi.org/10.5281/zenodo.7801300

Van Mensvoort, K. M. (2022). NextNature. Perché la tecnologia è la nostra natura del futuro. D Editore, Roma.

About the Authors:

Annapaola Vacanti: Research Fellow at Università Iuav di Venezia, she obtained a Ph.D in Design at the University of Genova in 2022. Her work focuses on the theme of Human – Technology Interaction. She has been art director of TEDxGenova since 2019.