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The Impact of Smart Interactive Technologies in Creating Personal Internal Spaces: An Analytical Study of User Preferences for Interactive Shape Characteristics

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ABSTRACT

As interactive technologies become increasingly prevalent in personal living spaces, understanding users' preferences and interactions with these technologies becomes crucial. This study aims to examine users' preferences for interactive technologies in personal living spaces, specifically focusing on interactive lighting, furniture, and space changes. The findings of this study will inform the design and development of future personalized interactive environments. A diverse group of participants completed a questionnaire assessing their preferences for interactive technologies in different home spaces. The collected data were analyzed using descriptive statistics. The results indicate a growing acceptance of interactive technologies in personal living spaces. Most respondents expressed a preference for interactive color change, followed by interactive furniture. Gender differences in preferences were also evident, with males showing a greater preference for form changes, while females favored interactive furniture. These findings have significant implications for the design of personalized interactive environments. It highlights the importance of considering users' preferences and involving them in the design process to create tailored experiences. This study contributes to the field by emphasizing the importance of researching interactive technologies and their potential applications in people's homes and environments. By providing valuable insights into designing and developing future personalized interactive environments, this research emphasizes the need to meet users' evolving needs and preferences to enhance their overall living experiences.

1. INTRODUCTION

Rapid technological industry development has revolutionised architectural design, including interior design, introducing novel ideas, functional solutions, and aesthetic elements that were previously unimaginable. These modern technologies have played a pivotal role in advancing interior design methods and generating innovative ideas beyond the scope of traditional approaches.

Consequently, intelligent, interactive, and virtual interior design has emerged as a progressive outcome. The design process now relies on proportions and functional aesthetics, leveraging all available tools and selecting appropriate technological techniques. These selected techniques aim to support users' preferences, ultimately enhancing their living experiences by providing environments that promote psychological and physiological well-being and access to intelligent interactive spaces tailored to their needs.

In this context, the objectives of our study are to examine users' preferences for interactive technologies in personal living spaces, with a specific focus on interactive lighting, furniture, and space changes. We aim to understand the factors influencing users' preferences and the potential implications for designing and developing future personalised interactive environments. By investigating users' experiences and interactions, our research seeks to contribute to enhancing living spaces that align with users' evolving needs and preferences.

2. LITERATURE REVIEW

The term "interactivity" was first introduced by Wiener in 1950 in his book "The Human Use of Human Beings," he defined it as a concept of reactions and a means of controlling the system. Subsequently, the phrase "Computation Everywhere", coined by Weiser [1], had a significant impact on the emergence of interactive spaces, which are interactive environments inspired by computer technology.

The development of the Internet of Things and automation in building design has driven the evolution of intelligent interactive architecture in response to user needs. As a result, interactive spaces have emerged that are compatible with societal and environmental conditions and personal preferences. The interactive architecture design process focuses on the mechanical behaviour of the space, user needs, and internal and external conditions rather than just the end product. Amini et al. [2] explain that the design process involves defining a model that can adapt to different user activities, and Boychenko [3] highlights that interactive design can also reflect social performance and allow for changes in form based on user preferences.

The increasing demand for adaptable and customisable spatial qualities in buildings has led to the emergence of interactivity as a prominent architectural feature. Interactive architecture offers an effective alternative to traditional building automation, fundamentally changing buildings' performance, uses, and maintenance. In this way, interactive architecture can create spaces that engage in continuous dialogue with their users and one another. Digital technologies have enabled interactive architecture to break down perceptual boundaries between virtual and physical worlds, allowing ongoing conversations between its components [2, 4, 5].

The primary objective of interactive design is to improve human life by utilising digital and modern technologies. It aims to minimise negative aspects such as discomfort by avoiding complex designs and offering user-friendly concepts while simultaneously creating positive aspects by providing comfort, pleasure, and a space that caters to individual user needs. Scholars have identified several critical goals of interactive design, including the determination of the behaviour of environments, systems, and products by defining their form, exploring the dialogue between interactive intelligent technologies and people, and anticipating the impact of their use on human relations [5-7]. Additionally, the interactive design aims to provide purposeful, enjoyable, and effective spaces and systems that prioritise user experience, are easy to learn and use, and prioritise safety.

2.1 The interactive environment effect on interior design characteristics

Recent research suggests that interior spaces and surfaces, such as walls, floors, and ceilings, will become increasingly adaptable, with the ability to alter their physical appearance, form, and colour, among other aspects. Nabil and Kirk [8] predict that the evolution of Human Building Interaction (HBI) will lead to the development of seamless sensing and actuation capabilities, enabling the generation of data paths that respond to users' activities. As a result, interactive architecture can generate new interior designs based on user preferences dynamically. This approach can help create environments that support users' psychological and physiological comfort and provide opportunities to design inner spaces incorporating multiple aesthetic aspects and meaning to form and function [9, 10]. Musa [11] emphasises that the built environment interacts with humans through interactive systems that define the environment, systems that can adjust their location based on user needs, and systems that directly communicate with the user.

An intelligent interactive space is an environment that engages with users and responds to their activities through various sensory forms, such as visual, auditory, kinesthetic, and tactile stimuli [11, 12]. Traditionally, the determinants of space were limited to rigid physical elements. However, in interactive architecture, the focus has shifted towards creating spaces that can recognise users' desires and interact with them to enhance their satisfaction while maximising the use of space [7]. Digital interactive spaces possess several characteristics, including integrating visual and sensory elements such as colour, light, and texture through intelligent materials, enhancing the perceptual experience by enhancing functional potential, and dissolving architectural boundaries between elements such as walls, ceilings, and floors. These spaces also expand the capabilities of architectural elements by transforming them into one another while simultaneously incorporating aesthetic capabilities.

The interactive design process employs several mechanisms to create an interactive inner space in three primary stages [7, 13]. While researchers differ in naming and organising these stages, they generally agree on the following:

- Firstly, the user's needs are identified and prioritised in terms of importance. This stage involves understanding the user's objectives, functions, and requirements within the space.
- Secondly, the objectives of the interactive design are established, which aim to create an interior design that can follow the user's activities, trends, and events within the space. The goal is to provide an environment where the user can feel the interaction.
- Thirdly, the interaction design stage involves transforming the user's needs and objectives into a design that describes or explains the user's movement within the space. This stage focuses on transforming information into an intuitive and interactive user experience.

Overall, the changes brought about by intelligent technologies in inner space can be significant. Intelligent structures, for example, can enhance the perceptual experience by integrating visual and sensory elements such as colour, light, and texture. Moreover, architectural boundaries can be dissolved through intelligent materials, expanding the capabilities of architectural elements. These changes enable designers to create interactive spaces that are both functional and aesthetically pleasing.

1. Change of space form

The intelligent interactive form presents a vision for transitioning from traditional fixed forms to forms that interact with the user's senses and adapt to their desires in a way that maximises the possibility of utilising spaces and obtains the user's satisfaction [10]. Changes in the form include everything that happens in the elements of the internal physical environment (floor, walls, and ceilings). Intelligent interactive technologies have provided many materials through which the elements of the internal space can be formed and interact with the user [14].

Figure 1. Aegis hypo surface

For example, the Aegis Hypo Surface (Figure 1) is a massive kinetic wall that triggers the form-shifting mechanism either autonomously (pre-programmed), reacting to people's gestures, movements, and hand manipulations, or responding to ambient sounds and noises [15].

Figure 2. Living surface

Figure 2 shows another example is the Living Surface [16], a form-shifting surface that interacts with users by changing its physical form in response to user physiological data that is measured using sensors and then provided in the form of visual and tactile feedback to change the form of the surface, which can be a wall in a house or even a roof. The smart wall, shown in Figure 3, also offers the ability to change its form as it works to create internal environments within the environment again, such as an office in the living room [17].

Figure 3. Example of smart wall

Overall, the use of intelligent interactive technologies in shaping the elements of the internal physical environment has revolutionised the field of interior design, providing novel and dynamic ways of creating interactive spaces that respond to users' needs and enhance their experience.

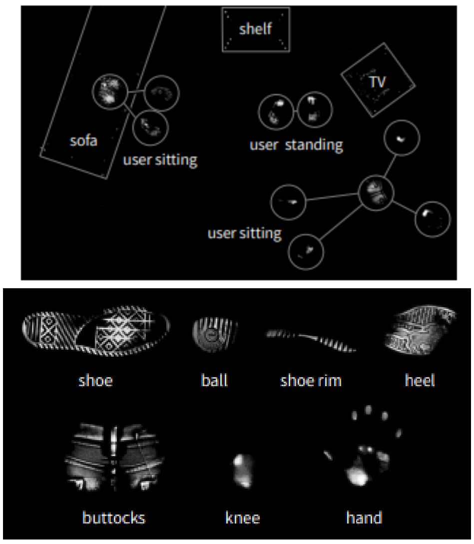

Figure 4. The effect of different pressure intensity

Figure 5. Interaction with virtual objects by tracking foot movement

The formal change in intelligent interactive design extends beyond walls and ceilings to even include floors. Gravity Space is one example of how floors can be transformed to interact with users. Additionally, interactive floors that dynamically transform based on user input have been developed [18, 19]. Figures 4 and 5 show examples of interactive floors that respond to the touch of their users. These floors can display images, such as an oriental carpet or a painting by an international artist, and once it recognises the fingerprints of its users, it initiates a dynamic transformation to create an interactive experience.

These advancements in interactive flooring provide the user with a unique interactive experience with the physical environment. The user's touch and movement are recognised and translated into real-time responses, enhancing the space's sensory experience. Moreover, interactive floors can be used for information sharing or entertainment in public spaces such as museums or shopping malls.

Overall, integrating interactive technology with physical elements such as floors opens up new avenues for designers to create intelligent spaces that can adapt and respond to users' needs and desires. It offers a unique and immersive experience that can lead to higher user satisfaction and engagement.

2. Change of space colour

Colours are crucial components in the design of interior spaces, as they can influence the form, size, and function of the space, as well as the psychological and physiological states of the users. Colours can evoke emotions and sensations such as pleasure, comfort, and anger [20]. In recent years, innovative technologies have been developed to design colour-interactive materials that enhance the user's experience and satisfaction. One example of these materials is smart pigments, such as thermochromic pigments, which can change colour in response to ambient conditions such as heat, light, and liquids. These pigments can be applied to various three-dimensional surfaces, including fabrics, wood, paper, and ceramics, to create interactive elements and spaces that blend various selected colours [8]. Figure 6 shows thermal tiles change colour by touch, temperature, and humidity during cooking, in addition to the automatic dynamic change, thus giving a continuously changing environment. Similarly, Figure 7 illustrates a shower changing the ceramic tiles' colour by a moving colour.

The use of smart pigments can contribute to creating interior spaces that are more adaptive to the needs and preferences of the users. For instance, the pigments can be used to create surfaces that change colour according to the temperature or lighting conditions in the room. This can create a more dynamic and responsive environment that adapts to the user's physiological needs and preferences. Moreover, using smart pigments can enhance the aesthetic appeal of the interior spaces and create a more visually engaging and stimulating environment [21].

In conclusion, using smart technologies and colour-interactive materials such as thermochromic pigments can create more adaptive and engaging interior spaces that enhance the user's experience and satisfaction. By incorporating these materials in the design process, interior designers can create spaces that are not only functional but also aesthetically pleasing and emotionally satisfying.

Figure 6. Thermal tiles change colour by touch, temperature, and humidity [8]

Figure 7. Shower with changing colour ceramic tiles [8]

3. Interactive lighting (change with light)

Numerous studies have demonstrated that intelligent interactive technologies have enabled lighting to interact with the user's desires, resulting in more user-friendly lighting that meets their needs. This includes considerations such as the intensity and colour of the light, as well as the number of lights needed [22, 23]. The importance of interactive lighting stems from its ability to influence the design of interior spaces in various ways, such as affecting the perception of the space's form, size, and colour and creating specific physiological effects for the user.

For instance, research has found that interactive lighting can help create a more comfortable and inviting environment for users, leading to increased satisfaction and well-being. In addition, interactive lighting can highlight specific features of a space, such as artwork or architectural details, to create a more engaging and aesthetically pleasing atmosphere [24]. Furthermore, interactive lighting can support specific activities, such as reading or cooking, by adjusting the light intensity and colour temperature to meet the user's needs [25].

Figure 8 demonstrates an example of the effects of interactive lighting on the design of interior space. Dynamic lighting in this space creates a warm and welcoming environment that enhances the user experience. The lighting design incorporates various colours and intensities of light to highlight specific features of the space, such as the fireplace and wall artwork, while providing ample illumination for everyday activities. The result is a cohesive and harmonious lighting scheme that improves the space's aesthetic and functional aspects.

Figure 8. Living-lab area interactive lighting project [26]

4. Interactive furniture

Furniture is vital in determining how users interact with their personal spaces, living styles, and cultural preferences, providing comfort and pleasure. With the advent of interactive technologies, a new architectural term, "Interior Action," emerged, which refers to integrating interior decoration with interactive design. This design approach incorporates decorative elements such as wall paintings, furniture, carpets, curtains, and other design elements to create interactive spaces that offer enhanced user experiences [27]. Smart furniture is an example of this approach, which incorporates technology and can respond to users' needs and desires. Figures 9 and 10 depict interactive furniture and decorative elements that employ this approach, creating a dynamic and engaging environment.

Figure 9. CONVX shape-changing seat [27]

Figure 10. MORVAZ The changing shape vase [27]

3. RESEARCH METHOD

This study employs a quantitative research approach, utilising an electronic survey with a closed-ended questionnaire to collect data. The sampling method used in this study is convenience sampling, whereby participants were selected based on their accessibility and willingness to participate. It should be noted that convenience sampling may introduce potential biases and limit the generalizability of the findings to the broader population.

The target population for this study includes residents of different social classes and age groups who have experience with intelligent interactive technologies in their living spaces. However, surveying the entire target population is not feasible due to practical constraints. Therefore, a representative sample was selected to gather insights into the preferences and acceptance of these changes.

A power analysis determined the sample size based on the desired confidence level, effect size, and acceptable margin of error. The assumption of a total sample size of 143 participants was made based on the power analysis and available data collection and analysis resources.

The final questionnaire consists of 28 questions about participants' preferences for interactive technologies. These questions were grouped together and accompanied by introductory paragraphs and explanations, supplemented with relevant pictures illustrating each variable and its applications. The questionnaire explored participants' preferences for interactive technologies, their acceptance of this type of technology in different spaces, the preferred types of spaces for specific changes, and the perceived impact of smart technology on their sense of comfort within their homes. Additionally, the questionnaire examined how this technology mitigates the feeling of home automation and facilitates interactive possibilities within space.

The data collected from the participants, aged between 20 and over 60, were analysed using appropriate statistical methods to identify patterns and trends in their responses. The study's findings will be discussed concerning prior research on the influence of intelligent interactive technologies on the design characteristics of inner spaces. Moreover, the results will provide valuable insights into personal preferences and acceptance of these changes among residents from different social classes and age groups. This study holds implications for the design of future living spaces and the utilisation of intelligent interactive technologies to enhance the quality of life for residents.

4. RESULTS ANALYSIS AND DISCUSSION

This study comprehensively analyses users' preferences and acceptance of interactive technologies in personal living spaces. We conducted a quantitative study using an electronic and closed-ended questionnaire to address the research objectives outlined in the introduction. This research aimed to explore users' preferences for interactive technologies, examine their acceptance of these technologies in various spaces, and investigate the role of smart technology in enhancing their sense of comfort while reducing the feeling of home automation. Furthermore, the study sought to investigate the impact of intelligent interactive technologies on the design characteristics of inner spaces. By employing these research methods, we aimed to gather data that would provide valuable insights into users' attitudes and behaviours towards interactive technologies and their potential implications for designing and developing personalised living environments.

The findings from the survey shed light on several interesting trends and preferences among participants. Firstly, the data showed that females expressed slightly more concern and interest in interactive interior design and furniture than males. At the same time, the slight difference suggests that gender may play a role in shaping preferences for interactive technologies in personal living spaces.

Secondly, the study found that younger participants showed greater interest in interactive technologies than older individuals. This finding aligns with the notion that younger generations are generally more open to and familiar with emerging technologies. It suggests that as the younger population ages and becomes homeowners, the demand for interactive technologies in personal living spaces may increase.

Furthermore, participants with higher educational backgrounds showed more interest in interactive interior design. This finding highlights the role of education in shaping individuals' preferences and awareness of technological advancements. It suggests that higher levels of education may lead to a greater appreciation for the potential benefits and value of interactive technologies in enhancing personal living spaces.

These findings underscore the importance of considering demographic factors, such as gender, age, and educational background, when designing and developing interactive technologies for personal living spaces. Understanding these preferences and variations among different groups can help tailor the design and marketing strategies better to meet the needs and expectations of the target audience. Future research could delve deeper into understanding the underlying factors contributing to these preferences and further explore the potential differences in attitudes and behaviours across various demographic segments.

The results showed that the most preferred technology for inclusion in respondents' homes was a colour change, with 57.3% of respondents choosing this option. This was followed by interactive lighting at a rate of 47.6%, interactive furniture at a rate of 42%, and a change in the form at 36.4% (see Figure

11). These results suggest that residents are most interested in changes to the visual aspects of their living spaces, such as colour and lighting, and that they are less interested in changes to the form or function of their furniture.

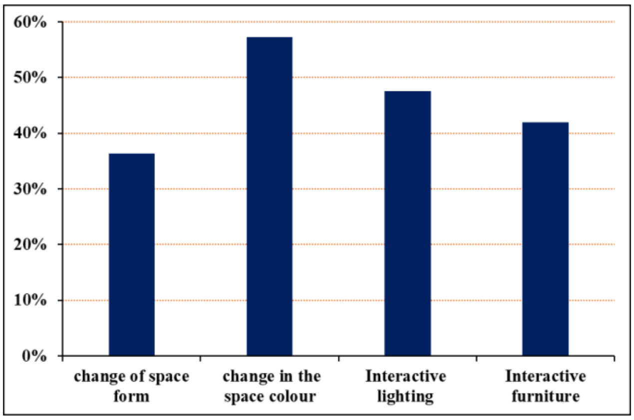

Figure 11. Preferred interactive intelligent technologies for inclusion in homes

These findings are consistent with previous studies that have found that residents prioritise visual aesthetics and ambience in their living spaces when incorporating smart technologies. For example, a study by Tigwell and Crabb [28] found that residents preferred smart technologies that enhanced the visual appeal of their homes, such as colour-changing lighting and interactive artwork. Another study by Wilson et al. [29] found that residents valued smart home technologies that could be customised to their individual preferences and enhanced their living spaces' overall aesthetic. However, this study also found that residents were less interested in changes to the form or function of their furniture compared to other aspects of their living spaces. This suggests that designers and builders may need to focus more on enhancing furniture's visual appeal rather than changing its form or functionality when incorporating smart technologies into furniture.

In response to the question about the most beneficial technology (see Figure 12), the results showed that 32.2% of respondents found interactive lighting to be the most helpful technology, followed by a colour change at 30.1%, interactive furniture at 22.4%, and form change at 15.4%. These findings suggest that residents consider changes to the visual aspects of their living spaces to be the most beneficial.

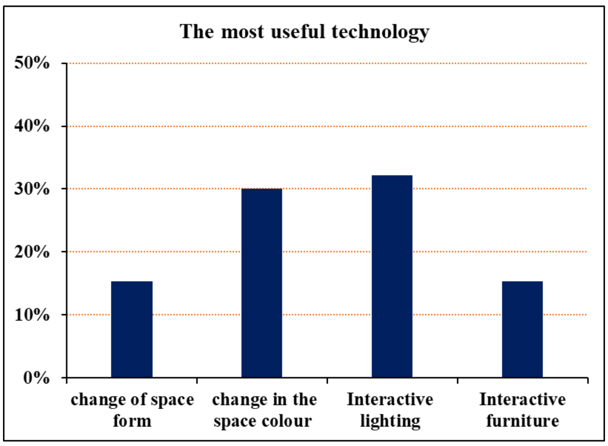

Figure 12. Most useful and beneficial interactive intelligent technologies

These findings are consistent with previous studies that have found that changes to the visual aspects of living spaces appeal most to residents when incorporating smart technologies. For example, Hu et al. [30] found that residents valued smart technologies that enhanced their homes' visual appeal and ambience. Another study by Zeng et al. [31] found that residents preferred smart technologies that could be easily customised to their individual preferences, particularly regarding lighting.

When asked about the best interactive form provided by the technologies (see Figure 13), the results showed that colour change technology came first with a rate of 27.3%, followed by interactive lighting at 26.6%, change in the form at 24.5%, and interactive furniture at 21.7%. These results suggest that residents prefer changes to the colour and lighting of their living spaces over changes to the form or function of their furniture.

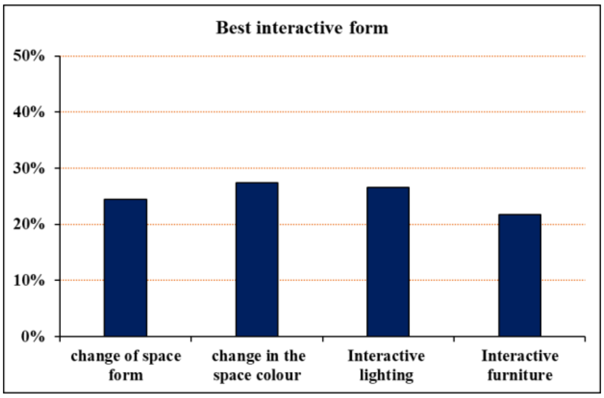

Figure 13. Preferred interactive forms provided by technologies

These findings suggest that designers and builders should prioritise changes to the visual aspects of living spaces, particularly colour and lighting, when incorporating smart technologies into homes. Additionally, the findings highlight the importance of customising and individualising smart technologies to meet residents' preferences and needs. By understanding what residents value and consider most beneficial, designers and builders can create smart homes that enhance residents' quality of life and well-being.

Figure 14 presents the technologies that are preferred by respondents for achieving personalisation in their living spaces. The results show that most respondents preferred changes to the colour of the space (32.9%), followed by interactive lighting (29.4%), interactive furniture (20.3%), and changes to the form of the space (17.5%). These findings indicate that respondents prioritise visual aspects of their living spaces regarding personalisation.

These findings are consistent with previous research that has found that residents value personalisation in their living spaces, particularly regarding visual aspects such as colour and lighting. For example, a study by Nikou [32] found that residents preferred smart technologies that could be easily customised to their individual preferences, particularly regarding lighting.

Furthermore, in terms of the property of technologies to store data and interactions and anticipate them, respondents indicated a preference for changes to the colour of the space (30.1%), followed by changes to lighting (25.9%), interactive furniture (23.8%), and changes to the form of the space (20.3%) (see Figure 15).

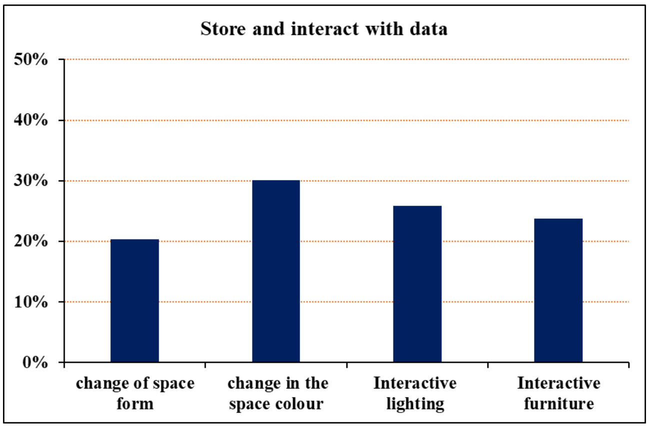

Figure 14. Preferred technologies for achieving personalisation in living spaces

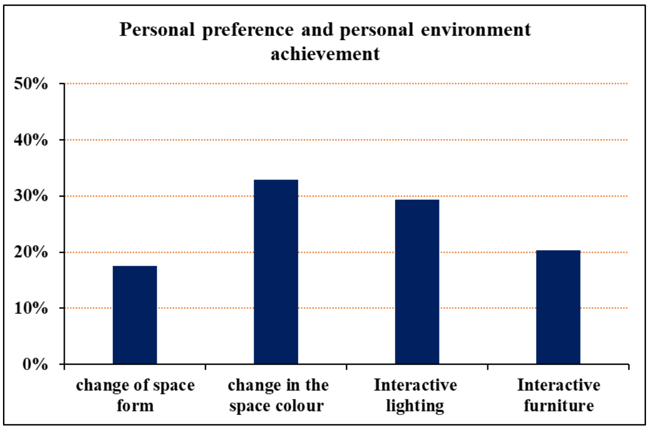

Figure 15. Preferences for technologies that store and anticipate data in living spaces

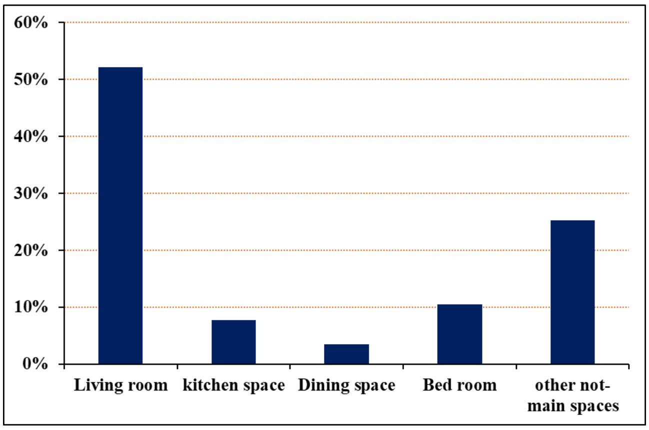

Figure 16. Preferred spaces for form-changing technology

These findings have important implications for the design of future living spaces that incorporate intelligent interactive technologies, as they suggest that residents prioritise personalisation and the ability of technology to anticipate their needs. By understanding what residents value and prefer regarding personalisation and anticipatory technologies, designers and builders can create smart homes that enhance residents' quality of life and well-being.

According to the questionnaire, respondents were queried on their preferences for living spaces that benefit from form-changing technology. As illustrated in Figure 16, the majority of respondents (52.1%) indicated a preference for form-changing technology in the living room, followed by non-main spaces (25.3%), the bedroom (15%), the kitchen (7.7%), and the food space (3.5%).

When respondents were asked which parts of the space they would like to interact with using form-changing technology, the interactive wall was the most popular choice, with 32.3% of respondents choosing this option. This was followed by interactive furniture at 30.9%, interactive ceiling at 25.3%, and interactive floor at 10.5%, as shown in Figure 17.

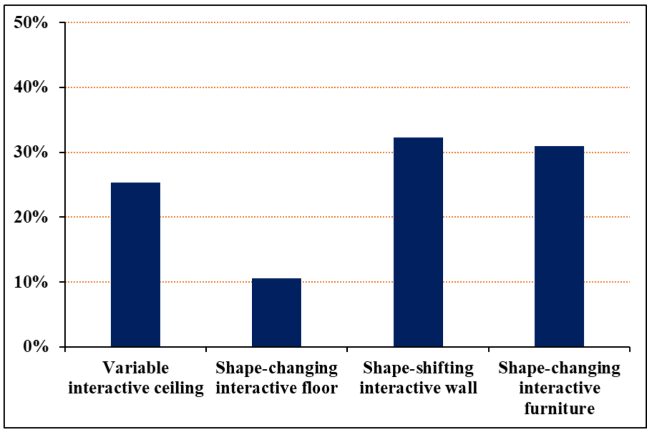

Figure 17. Preferred parts of the space for form-changing technology

These findings highlight the prioritisation of form-changing technology in specific areas and components of residential spaces, with the living room being the most preferred space and the interactive wall being the most preferred component for form-changing technology. These findings support previous studies showing the importance of the living room as a central and multi-functional space in residential settings [33, 34]. Additionally, the popularity of interactive walls and furniture as components to be interacted with using form-changing technology suggests the potential for creative and engaging design solutions in residential spaces. Form-changing technology could allow a more dynamic and adaptable living environment responding to residents' changing needs and preferences.

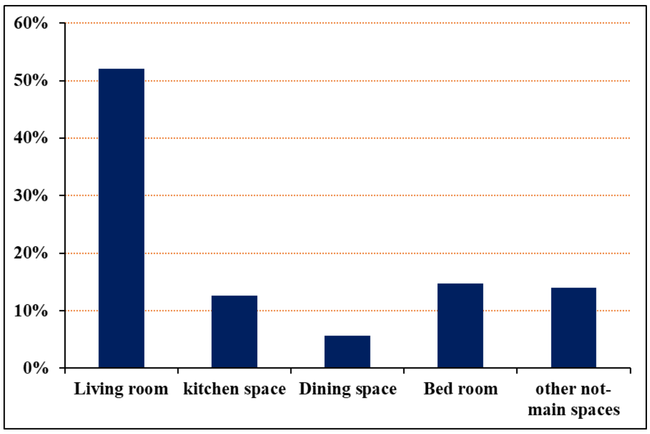

Figure 18. Participants' preferences for the most beneficial space regarding the interactive colour change

Figure 18 depicts the participants' preferences for the most beneficial space regarding the interactive change in the space's colour. Most participants (52.1%) found the living room the most beneficial space. This was followed by the bedroom

(14.7%), other non-main spaces (14%), the kitchen (12.6%), and the food space (5.6%). These findings suggest that the living room is perceived to be the essential space for implementing colour-changing technology.

Furthermore, participants also expressed a desire to interact with specific parts of the space in terms of colour, as presented in Figure 19. Of the participants, 42.9% preferred an interactive colour-changing wall, suggesting that the wall is a desirable location for implementing colour-changing technology. This was followed by interactive colour-changing furniture (25.3%), indicating that participants found it beneficial to interact with the colour of furniture items such as sofas and chairs. Additionally, 15.4% of participants preferred an interactive ceiling, and an equal percentage preferred an interactive floor, suggesting interest in implementing colour-changing technology on surfaces other than walls and furniture.

These results provide valuable insights into participants' preferences regarding implementing colour-changing technology in interior spaces. Such insights may be useful for designers and architects in developing innovative and user-friendly solutions for enhancing the user experience in indoor environments.

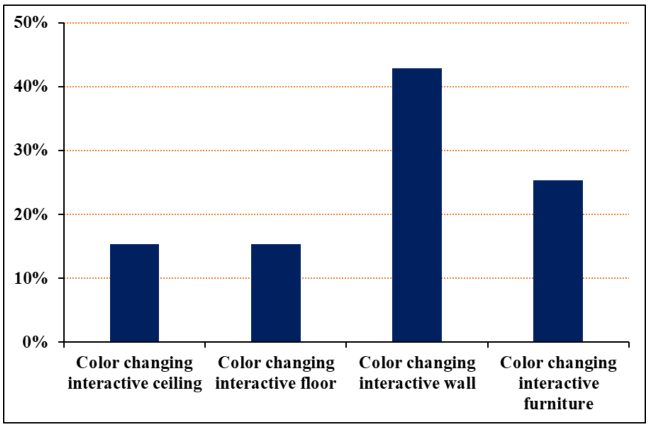

Figure 19. Participants' preferences for specific parts of the space to interact with in terms of colour

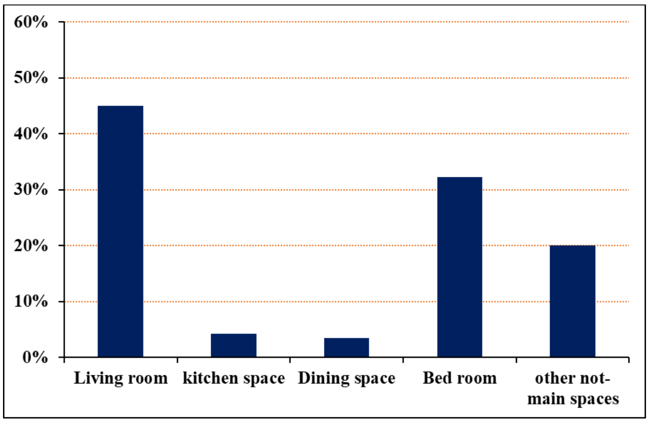

Figure 20. Participants' preferences for the most beneficial space for interactive lighting

The questionnaire used in this study also aimed to identify participants' preferences for interactive lighting in various spaces and to determine which spaces are perceived to be the most beneficial for implementing such technology. As presented in Figure 20, the living room was the most desirable space for interactive lighting, with 45% of participants indicating a preference for this space. This was followed by the bedroom (32.3%), other non-main spaces (14%), the kitchen (4.2%), and the food space (3.5%).

Moreover, Figure 21 shows the participants' preferences for interactive furniture in different spaces. The majority of participants (55.6%) preferred interactive furniture in the living room, followed by the kitchen (19%), other non-main spaces (12.6%), the dining space (9.1%), and the bedroom (2.8%). These findings suggest that participants perceive the living room as a key space for implementing interactive lighting and furniture technology.

These results provide valuable insights into participants' preferences for implementing interactive lighting and furniture in various spaces. The findings may be useful for designers and architects in developing innovative and user-friendly solutions for enhancing the user experience in indoor environments.

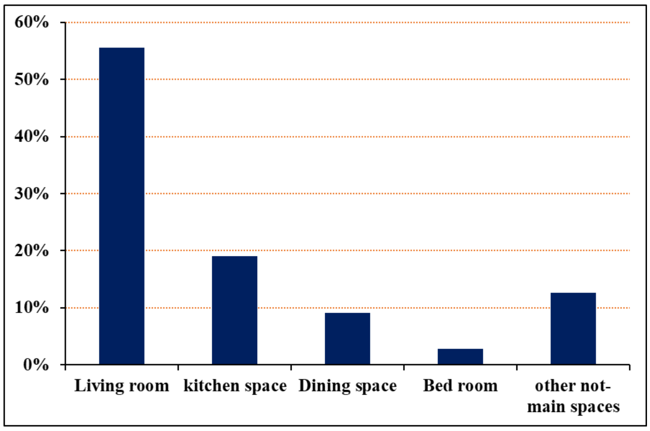

Figure 21. Participants' preferences for interactive furniture in different spaces

The questionnaire results indicated differences between the preferences of male and female participants. Regarding the change of form in the space, 22.5% of the male participants preferred to change the ceiling of the living room space, followed by the living room wall, with a rate of 21.1%. On the other hand, female participants preferred a changing form wall in the living room space (21.1%), followed by interactive furniture in the non-main spaces (14%) and in the kitchen and living room area (11%) for both genders. Regarding changing the space colour, 29.5% of the male participants preferred an interactive wall that changes colour in the living room space, followed by the ceiling in the living room space with a rate of 16.9%, then the wall in the bedroom space with a rate of 11.2%. Meanwhile, female participants preferred interactive furniture that changes colour in the living room space (21.1%), followed by the wall in the living room space with a rate of 15.4%, then with a rate of 11.2% for the wall in other non-main spaces.

Regarding the respondents' interactive lighting preference, 60.5% of the male participants preferred it in the living room space, followed by the bedroom space with a rate of 22.5%, and other non-main spaces with a rate of 8.4%. On the other hand, female participants preferred interactive lighting in the bedroom space with a rate of 42%, followed by the living room space with a rate of 29.5%, and other non-main spaces with a rate of 19.7%.

Both genders agreed on their interactive furniture preference in the living room at 59.1% for men and 52% for women. They also agreed not to prefer it in the bedroom space, with a rate of 2.8% for both genders. Male participants preferred interactive furniture in the kitchen space with a rate of 21.1%, then the dining space and other non-main spaces with a rate of 8.4% for each. In contrast, female participants preferred interactive furniture in the kitchen space and other non-main spaces with a rate of 16.9%, then the dining space with a rate of 9.8%.

5. CONCLUSIONS AND RECOMMENDATIONS

This study investigated users' preferences and acceptance of interactive technologies in personal living spaces. The research objectives encompassed exploring users' preferences for interactive technologies, examining their acceptance of these technologies in different spaces, and investigating the role of smart technology in enhancing their sense of comfort while reducing the feeling of home automation. Additionally, the study sought to explore the impact of intelligent interactive technologies on the design characteristics of inner spaces.

The findings of this study provide valuable insights into users' attitudes and behaviours towards interactive technologies in personal living spaces. The results indicate a high level of acceptance and interest among participants in utilising intelligent interactive technologies. Specifically, participants expressed a strong preference for interactive lighting, with the availability of lighting in different colours playing a significant role in enhancing users' experiences and creating a unique atmosphere in their living spaces.

The study found a lower level of interaction and preference regarding interactive furniture. This may be attributed to furniture pieces that change and transform without offering true interactivity, failing to provide a sense of distinctiveness and a unique atmosphere in each space. The findings suggest that respondents tend to gravitate towards spaces that offer a unique environment.

Furthermore, the study revealed that changes in shape had the lowest preference among respondents. People still prefer stable and fixed internal environments regarding dimensions and shape. However, respondents displayed a higher acceptance of changes in the wall, whether in colour or shape. This could be attributed to the history of architectural trends, where walls have undergone numerous transformations, making changing them more acceptable than altering the ceiling or floor.

Overall, the results of this study highlight the importance of understanding users' preferences and involving them in the design process of interactive technologies for personal living spaces. By considering user preferences, particularly colour-changing materials, designers can create personalised interactive environments that enhance users' experiences and cater to their unique needs.

These findings significantly affect the designing and development of interactive technologies in personal living spaces. Future research directions may include exploring the potential of interactive technologies in non-residential settings, developing more advanced technologies that adapt to individual preferences using machine learning and artificial intelligence, and investigating the use of interactive technologies to promote sustainable behaviours.

One of the most important and promising areas for future research lies in developing personalised and adaptive interactive technologies for personal living spaces. This entails exploring advanced techniques such as machine learning, artificial intelligence, and sensor integration to create intelligent systems that can learn and adapt to individual users' preferences, behaviours, and needs. By leveraging these technologies, we can design living spaces that dynamically respond to users' changing requirements, enhancing their comfort, convenience, and overall well-being. Additionally, investigating the potential of interactive technologies in promoting sustainable behaviours and energy efficiency within personal living spaces is an important area of focus. By integrating these technologies with energy management systems and smart devices, we can create eco-friendly environments that optimise resource utilisation and minimise environmental impact. Such research endeavours will contribute to developing innovative and user-centric solutions that genuinely transform how we live in our homes.

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