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Interactive "smart" glass as an element of forming an adaptive object-spatial environment

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Abstract. "Smart" glass, as a new material with functional and visual advantages, attracts the attention of architects and designers, opening up new opportunities for modern interiors. The growing number of projects and the lack of generalised experience have determined the relevance of the study. The aim of the work was to analyse trends in the implementation of interactive "smart" glass in the interior design of residential and public buildings, to determine its classification and functional and utilitarian capabilities in terms of forming an adaptive spatial environment. The research was based on a set of general scientific theoretical methods of cognition, which included the implementation of such methods as analysis, synthesis, classification, and generalisation. The author's definition of the concept of "smart" glass in terms of the formation of an adaptive space was provided. Based on the analysis of practical material, "smart" glass was systematised according to its functional and utilitarian capabilities in the formation of an adaptive object-spatial environment. As a result of the work, methods for implementing various types of "smart" glass in the interior design of residential and public spaces were identified. It was found that the most common are touch and projection technologies, which form a visual and communicative environment in public spaces. In residential interiors, "smart" glass performs a predominantly utilitarian function, contributing to energy conservation and privacy. The results also confirmed the aesthetic and functional potential of "smart" glass as an element of adaptive space. Systematisation of material on the implementation of "smart" glass in modern interiors will enable Ukrainian architects and designers to apply theoretical knowledge in design practice to create interactive object-spatial environments. The presented theoretical developments can serve as a basis for predictive design solutions using certain types of "smart" glass

Keywords: interior design; innovations; "smart" technologies in environmental design; technologisation of space; modern trends

INTRODUCTION

The formation of modern interiors for residential and public spaces is based on the desire for spatial adaptability. One of the innovations that can meet this demand is "smart" glass. This technology allows to take a new look at the process of organising space, and the variety of its types and special properties enable designers to implement new concepts of space organisation. The development of these technologies and their active implementation in interior design highlights the need to systematise extensive empirical experience for the convenience of its implementation in further design practice.

The issue of using "smart" glass in interior design has been considered by both Ukrainian and foreign scientists. Among the publications of Ukrainian researchers

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analysing the implementation of innovative technologies in environmental design, the collective work of I. Bondarenko *et al.* (2022) should be highlighted. The work identified the leading c ompositional techniques for the placement of interactive sensory objects in the interiors of public buildings. The authors determined that the placement of such objects is most often carried out according to two leading compositional schemes: based on a grid system and according to a radial scheme. The researchers emphasised that interactive multimedia objects add adaptability and attractiveness to the interior, which is an important factor in the formation of modern public space. The advantages of introducing interactive technologies in the interior design of public establishments such as commercial institutions were considered in the work of A. Obeidat *et al.* (2020). The authors emphasised that the use of innovations is intended to attract the attention of visitors and create a new experience of interaction between potential buyers and the goods presented in the commercial space.

In the context of this study, it was important to consider scientific works devoted to the analysis of modern "smart" materials and the specifics of their implementation in the architectural environment. The study by Q. Chen *et al.* (2024) considered the issue of modelling interactive materials in the development of adaptive structures. The researchers noted that "smart" materials, which change their properties under the influence of external factors, are characterised by non-linear behaviour and complex constitutive models, which significantly complicates the process of their design. The team of authors M. Al Alim *et al.* (2025) examined the characteristics of innovative "smart" polymer materials. The researchers noted that such materials have a wide range of functional purposes, environmental sustainability, and multidisciplinary applications. The authors emphasised that the introduction of these materials into architecture, construction and engineering will increase the stability and durability of structures.

The prospects for the introduction of "smart" materials in construction and architecture in China were analysed in a study by S. Xu (2024). The scientist considered the use of piezoelectric "intelligent" materials and technologies for phase transition energy storage. This issue was studied from the perspective of energy efficiency, where the use of smart materials is consistent with the concept of sustainable development and solves the problem of high energy consumption in construction. The work of M. Abdelaal (2022) examined the features of the implementation of smart systems in the architecture of administrative buildings in Egypt. Such systems have a positive impact on construction at the environmental, social and economic levels. Buildings equipped with "smart" technologies represent an interconnection of design solutions, control systems, maintenance and management. The interior space of such a building adapts to the needs of the user, ensuring maximum comfort for human life.

The issue of implementing "smart" glass in Egyptian architecture was discussed in an article by M. Hassan *et al.* (2025). The researchers examined this issue from the perspective of sustainable development, where access to affordable and renewable energy resources is important. The researchers note that energy consumption and thermal comfort in modern office buildings in the region are critical factors that must be taken into account at the design stage. Total glazing of buildings has a negative impact on the thermal comfort of people who are constantly in such spaces. The authors noted that one solution for regulating the thermal characteristics of the interior is glazing with the use of "smart" glass. The issue of creating windows equipped with "smart" glass was highlighted in a study by Y. Zhou *et al*. (2021). During the experiments, the scientists found that such a window has reduced energy consumption with a high light transmittance coefficient. The researchers emphasised that in terms of energy efficiency, windows are one of the lowest-performing elements in a building's construction – in summer, more than 70% of heat is transferred into the room through windows, and in winter, windows account for 30% of heat loss. Thus, the use of "smart" glass in architecture is environmentally and economically viable. A similar issue was addressed in a comprehensive study by S. Nundy *et al.* (2021), where scientists noted that a building equipped with windows with "smart" glass actively consumes the electricity generated by its own system. This is what allows to meet the needs for air conditioning, heating and artificial interior lighting.

A thorough analysis of the current scientific literature on this issue has shown that most researchers focus on the technical features of smart technologies and materials, while the issue of implementing smart glass in the interior design of public and residential buildings has not been comprehensively covered and requires more in-depth analysis. This determined the aim of the scientific article, which was to systematise practical material, conceptualise the notion of "smart glass" and classify this "smart" technology according to its functional purpose in the field of interior design for residential and public spaces.

MATERIALS AND METHODS

To achieve the set goal, a complex of general scientific theoretical research methods was used, including analysis, synthesis, classification, and generalisation. The authors used the analysis method to study the components of the design of the object-spatial environment, in which the implementation of "smart" materials is observed. The main criteria for the analysis of this theoretical study were objectivity and validity (in their research, the authors relied on factual material – implemented design projects and prognostic design developments presented to the general public, where "smart" glass was used) and systematicity (which was used in structuring disparate material according to the type of action of "smart" glass). The analysis helped to identify ways of placing interactive objects in a spatial environment. Synthesis was implemented when summarising design experience and deriving methods for implementing "smart" glass in a spatial environment. The classification method was implemented to identify groups of "smart" glass and determine a number of functional advantages of implementing this technology in modern interior design, and the application of the generalisation method allowed to summarise the conclusions of the work.

The leading materials of the study were public interiors, which include museums, exhibition and educational centres, office premises, shopping and entertainment complexes, and hotels. These included the Porsche "Mobilitätszentrum" museum (n.d.), the VW Exposition Center (Hammadeh, 2017), the Hiltol hotel (Virtual On, n.d.) and Microsoft (Archilovers, 2013). The use of these cases made it possible to identify the specifics of integrating sensory, projection and holographic glass into public spaces. Analysis of the examples made it possible to refine the compositional techniques for placing interactive surfaces, determine their functional roles in the formation of an adaptive object-spatial environment, and outline the possibilities for the variable integration of "smart" glass into contemporary design practice. It is in the interiors of these objects that the trend towards the active introduction of "smart" glass technologies is most clearly visible, providing variable opportunities for the formation of both functional and artistic solutions for the object-spatial environment. In addition, a number of private residential interiors were considered, where the introduction of "smart" glass began to spread.

RESULTS AND DISCUSSION

In scientific sources, "smart" glass (glass with variable properties) is defined as a composite material consisting of layers of glass and special chemical components and characterised by adjustable optical parameters, in particular opalescence, light transmittance and heat absorption (Mohamed, 2017; Cannavale *et al.*, 2020; Qahtan *et al.*, 2023). These properties change under the influence of external factors such as light intensity, temperature, mechanical impact or the application of electrical voltage. The use of smart glass in structures allows it to adaptively respond to climatic changes throughout the year by adjusting the level of transparency both manually and automatically under the influence of external environmental factors. Based on methods of analysis and generalisation of practical material, the author's definition of the concept of "smart" glass was proposed: it is a multi-component interactive surface that changes its appearance (degree of transparency or audiovisual information) under the influence of external factors, becoming an element in the formation of an adaptive space. "Smart" glass is formed according to two leading systems: triplex consisting of two layers of glass (or polymer) and a layer of chemical material placed between them; and a single glass (and/or polymer, mirror) surface and an audiovisual information control system (projector, films, touch frames, etc.).

For the most effective implementation of smart glass in interior design, it is necessary to understand the specifics of this material, its varieties and technical capabilities. Modern design practice shows that, according to its functional purpose, "smart" glass can be classified into the following large groups: 1) glass for displaying audiovisual information; 2) glass for creating privacy and functional zoning of the interior; 3) glass for accumulating solar energy and transforming it into a space energy supply system (Table 1).

Table 1. Classification of "smart" glass by functional purpose

Purpose	For demonstration of audiovisual information			For creating privacy and zoning	For accumulation and transformation of solar energy
Type	Sensory	Holographic	Projection	Electrochromic	Photovoltaic
Application area	Information and advertising stands, functional and exhibition equipment, furniture.	Information and advertising stands, exhibition equipment.	Partitions in public interiors, exhibition equipment, information stands.	Partitions in public and residential interiors.	Windows in residential and public buildings.

Source: created by the authors

The group of glass with the ability to display audiovisual information includes sensory, holographic and projection "smart" glass. Among these types of "smart" glass, sensory glass is the most common. This type of glass is created by using a touch film or infrared frame that turns a monitor screen or ordinary glass into a touch screen. Sensory "smart" glass performs advertising and informational functions and allows a person to control the audiovisual information displayed on the screen. Sensor systems are used in conjunction with a projection screen or LCD/plasma/LED monitor. Sensory screen control can be achieved in two ways: using iTouchScreen projection sensor film or iFrame infrared frames. Touch-sensitive "smart" glass is actively used in public interiors as information stands of various configurations, including flat horizontal panels (table tops), wall-mounted information panels, and separately located blocks of various geometric shapes (Nabil & Kirk, 2019; Kysil & Krotova, 2024). Such objects are most variably represented in museum and exhibition complexes, shopping and entertainment centres, and office interiors (Fig. 1).

a b c

Figure 1. Sensory "smart" glass in interior design
Note: a – VW Exposition Centre; b – "Porsche" Museum; c – Microsoft Centre
Source: Porsche "Mobilitätszentrum" (n.d.), Archilovers (2013), M.A. Hammadeh (2017)

In the design of the object-spatial environment, the use of interactive sensory "smart" glass is possible due to its combination with enclosing surfaces or portable objects and integration into stationary equipment (information stands). Thanks to the wide possibilities for integrating sensory "smart" glass into interior equipment, Ukrainian scientists I. Bondarenko *et al*. (2022) have identified the leading compositional techniques for placing such objects in public interiors: a checkerboard arrangement of three-dimensional forms; placement of objects along the compositional axes of the interior; grouping of objects with touch panels in the central part of the interior; placement of sensory objects around the perimeter of the space with a free central space; grouping of elements and their placement at an equal distance from the geometric centre of the interior; installation of sensory objects along a curved trajectory.

In residential interiors, the introduction of sensory "smart" glass is fragmentary. The inclusion of these innovations implements the concept of space technologisation, which is reflected in design proposals for interactive mirrors for bedrooms and bathrooms. Global design practice shows that the implementation of touch-sensitive objects is the most widespread and variable among all types of "smart" glass (Obeidat *et al*., 2020; Bondarenko *et al*., 2022; Ashou & Rashdan, 2023). This is due to the possibility of integrating panels with touch-sensitive "smart" glass into stationary interior equipment (furniture, partitions, advertising and information stands, etc.), which opens up new perspectives in the field of design development of environmental objects equipped with "smart" technologies. The spread of this type of glass is also influenced by the ability to add touch panels to an existing physical environment (when the inclusion of innovative technologies in the space was not planned at the design stage and during the initial equipping of the interior). In addition, the level of saturation and clarity of the image on the touch screen surface is significantly higher than the brightness of visual effects created using video projection systems.

Despite the difference in the representation of visual information, projection technologies are also used as an element in the formation of the spatial environment. One option for implementing projection systems is holographic "smart" glass, which is transparent glazing with a special projection film applied to the surface, allowing the visual effect of holographic images to be achieved. Glazing (shop windows, partitions, advertising stands) imitates holographic images through the use of a projection screen. Transparent projection film allows any existing glass surface to be transformed into a high-quality "holographic" screen. ClearView transparent projection film is applied to any existing glass (similar to protective film). Objects behind the screen remain visible, while ensuring high brightness and image sharpness (Virtual On, n.d.). Holographic "smart" glass is used in shop windows and advertising displays, information stands, museum and exhibition spaces, hotels, and shopping and entertainment centres. Such glass is usually installed in interior spaces in such a way that there is space behind the glass surface. This further emphasises the transparency of the surface. Holographic images often become elements of advertising or an analogue of an information stand. Such objects attract the attention of visitors and are installed exclusively in public interiors (Fig. 2).

If holographic glass forms a projection behind which space can be observed, then projection "smart" glass creates an opaque layer with an audiovisual image. This technology is based on the implementation of a projection film that is applied to the surface of the glass (shop windows, windows, interior partitions) and transforms it into a screen for a projector of any size. This projection system includes components such as projectors (light image sources), a screen (makes the image visible), and a control system (generates images or videos, ensuring the transmission of information and commands from a personal computer or other media).

Projection films allow to turn any translucent surface into a projection screen. When using different types of projection films, it is possible to position the projector behind the screen (back projection) (Fig. 3) or in front of the screen. The advantages of such films are: variability in size, transparency, cost-effectiveness, resistance to changing weather conditions, high contrast and image brightness.

a

b

Figure 2. Holographic "smart" glass in interior design
Note: a – Hiltol Hotel; b – holographic "smart" glass in window display design
Source: Virtual On (n.d.), Ascend (n.d.)

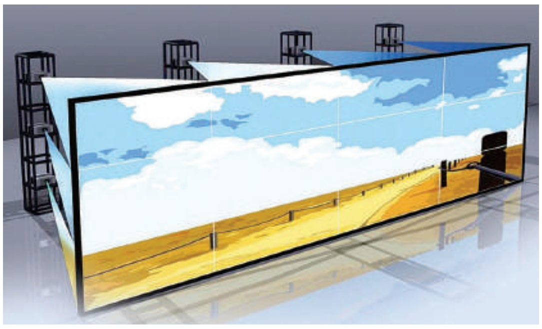

Figure 3. Projection "smart" glass system
Source: S. Mark (2021)

In the design of public interiors, "smart" glass can be used as an element of zoning the object-spatial environment, in particular in the form of interior partitions in offices, hospitals, shops and other establishments (Fig. 4). It can also be used to form entrance areas, for example in the design of shop windows and catering establishments. In addition, such glass can serve as an advertising medium in the form of billboards or information stands in museum and exhibition complexes and shopping and entertainment centres, as well as an element that forms a distinctive artistic image of the premises. It should be noted that projection "smart" glass is most often used in public interiors, due to the multi-component nature of this system, the scale of the projections and the attractiveness of the visual effects, which can reproduce both static images and videos.

Figure 4. Projection "smart" glass in office interior design
Source: PlanBar (n.d.), Smart Glass Country (n.d.a)

The next group of "smart" glass, which is actively used in modern interior design, is glass for creating privacy and functional zoning of space. This group includes electrochromic "smart" glass. It allows to change the absorbing properties of a transparent surface. Under the influence of electrical voltage, the glass switches between two fixed modes: transparent and opaque ("milky" or darkened) (Binswanger Glass, 2017; Architectural Products, 2023). The change in the light transmission of the glass surface is due to the introduction of a special liquid crystal electrochromic film, which is installed between two layers of glass (or polymer plexiglass) and, when connected to electricity, changes its state from a white opaque coating to transparent glass (Fig. 5).

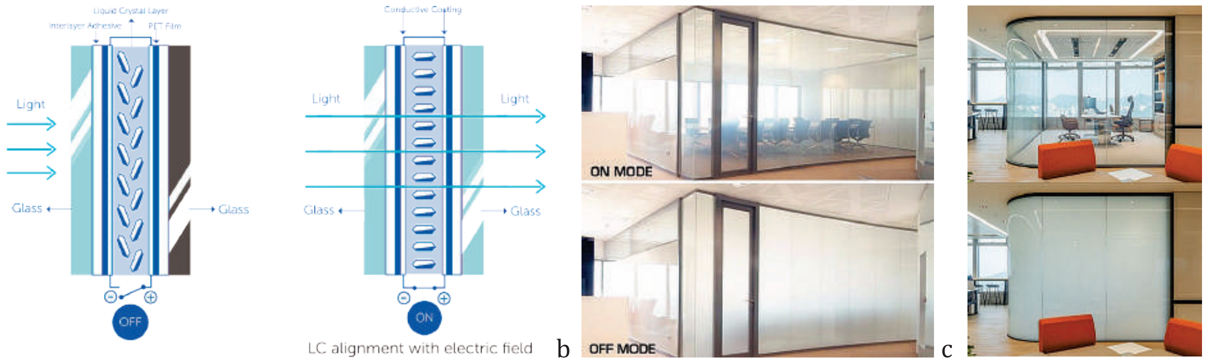

Figure 5. Electrochromic "smart" glass in public interior design
Note: a – principle of operation of "smart" glass with a liquid crystal layer (LC) electrochromic "smart" glass in a shopping centre; b, c – application of electrochromic "smart" glass in the interior of an office space
Source: Binswanger Glass (2017), A. Kavukcu (2017), Gauzy (2019)

The main advantages of this technology are low energy consumption, reduced lighting and air conditioning costs, material durability, safety for human health, and ease of use. Like projection glass, this type of glass is used for zoning spaces and in the interiors of office premises, hospitals, and residential spaces (Fig. 6) (Gavrilovic & Stojic, 2011). In addition to the introduction of electrochromic "smart" glass into the living environment, the use of photovoltaic (photoelectric) "smart" glass is becoming widespread (Fig. 7). This type of glass accumulates solar energy and transforms it into a power supply system for the space. It is this technology that makes it possible not only to regulate the degree of transparency of the glass surface of the window, but also to provide additional electricity to the interior space of the room. Photovoltaic "smart" glass converts ultraviolet and infrared radiation into electricity, which is used to support human life inside the room (Cannavale *et al*., 2020).

Figure 6. Application of electrochromic "smart" glass in residential interiors
Source: Smart Glass Country (n.d.b)

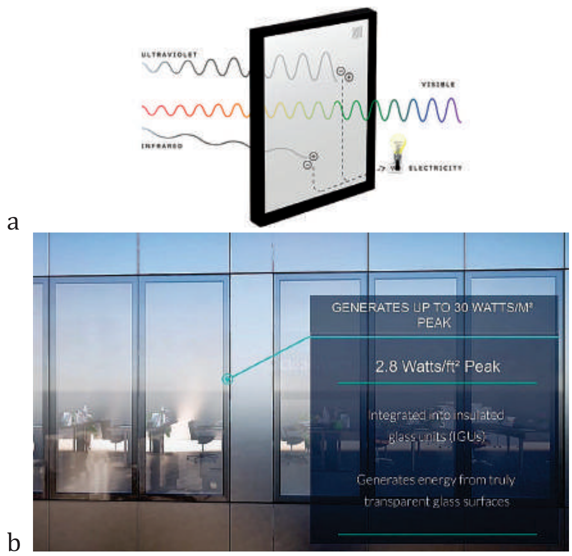

Figure 7. Photovoltaic "smart" glass
Note: a – principle of operation of photovoltaic "smart" glass; b – implementation of "smart" glass in architecture (facade fragment)
Source: Smart Glass World (n.d.), P. Segui (n.d.)

In terms of artistic and visual design in residential interiors, "smart" glass plays a secondary role, becoming a useful technology for creating a favourable environment for human life. Photovoltaic or electrochromic "smart" glass does not affect the artistic image of the interior. In public buildings, however, "smart" glass is subordinate to the overall style of the physical environment. Objects equipped with "smart" glass technology (stands, panels, display cases, furniture) often become compositional accents of the space, which is associated with both the expressive form of the objects themselves and the interactivity of the integrated elements that change the transparency and/or audiovisual information on the surface. Based on the analysis of the project material, the leading techniques for implementing "smart" glass into the design of the object-spatial environment were identified (Table 2).

Table 2. Techniques for implementing "smart" glass into interior design

Technique	Location of implementation	Suitable types of "smart" glass	Goal
Creation of a solid glass surface in the object-spatial environment	Interior partitions, shop windows, windows, attic windows, and ceilings.	Electrochromic, projection, holographic, photovoltaic.	Attractiveness of the space (visualisation and advertising function); adaptive zoning; regulation of interior insolation and ecology (accumulation and utilisation of solar energy).
Fragmented inclusion of "smart" glass in stationary space equipment	Information stands, interactive mirrors.	Electrochromic, sensory, projection, holographic.	Attractiveness of the space; interactive presentation of information and adaptiveness of objects; visitor interaction experience with an interactive object; technologisation of the object-spatial environment.
Integration of "smart" glass with portable interior objects	Interior equipment and furniture.	Sensory.	Adaptiveness of objects; visitor interaction experience with an interactive object; technologisation of the object-spatial environment.

Source: compiled by the authors based on A. Nageib *et al*. (2020)

The use of "smart" glass in interior design has its own definitions depending on the functional purpose of the space. For public interiors, it is more common to include smart glass as an element in the creation of partitions, stands, and showcases. For residential spaces, the implementation of these "smart" systems is typical in window openings and in bathrooms and bedrooms (interactive mirrors and panels). The implementation of this technology is one of the means of forming an adaptive object-spatial environment, where visitors and/or employees of public institutions have the opportunity to adjust the audiovisual image on the surface of objects equipped with sensory and projection "smart" glass, the degree of transparency of partitions with electrochromic "smart" glass, and the insolation of the space (when windows are equipped with "smart" glass technologies).

According to scientific research by S. Nundy *et al.* (2021) and A. Hatem *et al.* (2024) on the implementation of photovoltaic "smart" glass in office spaces, it was found that the use of such technology contributes to improving the microclimate in the interior and working conditions, saving electricity, solving the problem of solar energy accumulation and its use in the maintenance of public buildings, which is confirmed by the author's research. It should be noted that the scientific research of S. Nundy *et al*. (2021) and A. Hatem *et al.* (2024) are thorough works focused on the technical and technological aspects of the functioning and advantages of introducing "smart" glass into public interiors. However, the issue of implementing such technologies in the residential spatial environment remains unresolved. An analysis of completed projects (Smart Glass Country, n.d.b; Binswanger Glass, 2017) has shown that in residential spaces, this technology also aims to save energy and promote environmental friendliness, where rational energy consumption is becoming an increasingly pressing issue. In addition, the introduction of this technology makes it possible to avoid using textiles on windows if the interior design style calls for a minimalist approach or if the internal layout of the space does not allow for the use of textiles to decorate window openings (complex architecture, lack of room height, designed curvature of surfaces, etc.). The absence of textiles on windows may also be due to the customer's desire – allergies to dust that actively accumulates on textiles, the presence of pets that can damage expensive textiles, etc. In this case, the introduction of "smart" glass may be a viable alternative to more traditional solutions. These conclusions are consistent with the provisions of the theoretical model of tectonics of modern architectural forms proposed by A. Davydov *et al*. (2024), where integrativity, adaptability, and environmental friendliness are identified as key principles of modern architectural thinking.

According to scientific research by A. Mukherjee *et al.* (2023), it has been determined that in the fields of architecture and construction, the introduction of "smart" materials can be carried out either separately or in combination with traditional materials. The authors noted that in the near future, priority in the field of architecture and construction will be given to innovative materials that are functional, versatile, economical, and environmentally friendly. As confirmed by the authors' research, "smart" glass, which is one of the innovative developments in the field of energy efficiency, environmental friendliness and multifunctionality of materials, fully meets this requirement. As a result of theoretical research by M. Yildirim & Z. Candan (2023), six types of "smart" materials were identified: shape memory materials, piezoelectric materials, magnetostrictive materials, electrorheological and magnetorheological fluids, and self-healing materials. Among these types of "smart" materials, self-healing materials are widespread and have the potential to increase service life. This definition was confirmed by the authors' research: when analysing the characteristics of such types of "smart" glass as electrochromic and photovoltaic, it became clear that these materials are self-healing – their appearance and internal physical properties (after use) return to their original values.

According to a study by A.S.Y. Mohamed (2017), "smart" glass is one of the options for finishing (non-construction) materials, which is divided into active and passive. This classification is based on the presence or absence of an electrical stimulus that activates such glass. Based on the results of the study, the author notes that "smart" glass is suitable for use in the decoration of windows, doors, partitions, and solar roofs. These conclusions are confirmed by the authors' research, which found that, in addition to the above-mentioned areas, "smart" glass is also suitable for use in information and advertising stands, furniture elements, shop windows, and exhibition equipment in museums and exhibition centres, where "smart" glass becomes an element in the creation of a modern, attractive and interactive space. This issue was considered in the work of L. Bassey *et al.* (2025), where the authors analysed the possibilities of creating an adaptive interior through the introduction of "flexible" partitions. The work discussed various methods of creating an adaptive space through the regulation of temperature, insolation and energy conservation. However, such an innovation as "smart" glass, which solves these problems, has been overlooked by scientists.

The analysis of the implementation of "smart" systems in the formation of the space of an architectural object was carried out in the theoretical studies of R. Chasta *et al*. (2016). The authors studied the technical aspects of the implementation of modern smart systems (structural designs, adaptive control and automated space maintenance technologies, etc.) and promising developments in this field, based on the economic, environmental and functional advantages of smart technologies and the growing needs of users for comfort, aesthetics and safety in residential and public spaces. These aspects were considered in the work of M. Hu (2020), which outlined the history of the creation of "smart" buildings, analysed the prospects for the implementation of "intelligent" technologies in the architecture of civil structures and determined their multifunctionality. These results were confirmed by the author's research, which determined that "smart" glass meets the requirements for the formation of an innovative adaptive object-spatial environment.

According to the results of a study by S. Kysil & T. Krotova (2024), it was found that Ukrainian society currently has a pressing need to create an inclusive space saturated with interactive technologies. One of the main tasks that these innovative technologies solve is the activation of all human senses in the object-spatial environment, which is especially relevant for people with special health needs. The results of the work by S. Kysil & T. Krotova were confirmed by the authors' research in the field of implementing "smart" glass as an element in the creation of touch screens and panels for public interiors such as shopping centres, museums, exhibition centres and educational centres.

Modern innovative technologies and "smart" materials have opened up new opportunities for designers and architects in the field of organising the spatial environment of residential and public spaces. It has been found that "smart" glass, as one of the innovative developments of the 21st century, has become one of the elements in the formation of an adaptive spatial environment, because when it is used, the user can change the audiovisual information on its surface as needed, select the transparency mode of the glass, or regulate the energy supply of the home.

CONCLUSIONS

A review of scientific publications and examples of the use of "smart" glass has allowed to identify the advantages of smart technologies that influence the design of the physical environment: adaptability; energy efficiency; environmental friendliness; variability of "smart" glass sizes (from small integrated panels to large interactive surfaces); the ability to create planes of varying curvature (both flat shapes and curved surfaces); representation of audiovisual information on the glass surface using various media. The study found that, in terms of functional purpose, "smart" glass can be classified into three main groups: glass for displaying audiovisual information; glass for creating privacy and functional zoning of the interior; glass for accumulation. The work also outlines the main techniques for integrating "smart" glass into design: creating solid glass planes in the object-spatial environment, fragmentary inclusion in stationary equipment, and combination with portable interior objects. The above-mentioned advantages and areas of application of "smart" glass demonstrate the wide possibilities for implementing this technology in the interior design of residential and public spaces, where the formation of a modern adaptive spatial environment is an important requirement. The results of this work can serve as a basis for further scientific research aimed at analysing the formation of certain types of public interiors, in particular office premises, museum and exhibition complexes, or shopping and entertainment centres. It should be noted that the issue of introducing innovative technologies in the formation of an adaptive object-spatial environment for persons with disabilities is relevant, therefore further scientific research can be conducted based on the principle of matching technical innovations to the physiological needs of persons with disabilities, guided by ergonomic, functional, structural, and psychological indicators.

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Інтерактивне «розумне» скло як елемент формування адаптивного предметно-просторового середовища

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Анотація. «Розумне» скло як новий матеріал із функціональними та візуальними перевагами привертає увагу архітекторів і дизайнерів, відкриваючи нові можливості для сучасних інтер'єрів. Зростання кількості проєктів і відсутність узагальненого досвіду визначили актуальність дослідження. Метою роботи став аналіз тенденцій впровадження інтерактивного «розумного» скла в дизайн інтер'єру житлового та громадського призначення, визначення його класифікації та функціонально-утилітарних можливостей в аспекті формування адаптивного предметно-просторового середовища. Дослідження базувалося на комплексі загальнонаукових теоретичних методів пізнання, що включало впровадження таких методів як аналіз, синтез, класифікація та узагальнення. Надано авторську дефініцію поняття «розумне» скло в аспекті формування адаптивного простору. На основі аналізу практичного матеріалу було систематизовано «розумне» скло за функціонально-утилітарними можливості при формуванні адаптивного предметно-просторового середовища. В результаті роботи були визначені прийоми впровадження різних видів «розумного» скла в дизайн інтер'єру житлового та громадського простору. Встановлено, що найпоширенішими є сенсорні та проекційні технології, які формують візуально-комунікативне середовище в публічних просторах. У житлових інтер'єрах «розумне» скло виконує переважно утилітарну функцію, сприяючи енергозбереженню та приватності. Результати також підтвердили естетичний і функціональний потенціал «розумного» скла як елемента адаптивного простору. Систематизація матеріалу щодо впровадження «розумного» скла в сучасний інтер'єр дасть змогу українським архітекторам і дизайнерам застосовувати теоретичні знання у проєктній практиці для створення інтерактивного предметно-просторового середовища. Представлені теоретичні напрацювання можуть слугувати основою для прогнозних дизайн-рішень із використанням окремих видів «розумного» скла

Ключові слова: дизайн інтер'єру; інновації; «смарт»-технології в дизайні середовища; технологізація простору; сучасні тенденції