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RESEARCH ON THE CLASSIFICATION OF AVATARS IN DIGITAL ENVIRONMENTS

Purpose. *The aim of the research is to examine the digital avatar in terms of the diversity of its forms of representation, creation methods, and personalization possibilities, in order to identify and systematize the main criteria for its classification. The study seeks to highlight the specific characteristics of avatars used in gaming, the fashion industry, and virtual environments, as well as to establish a conceptual distinction between the digital avatar, the three-dimensional character, and the virtual human. The results of the analysis will contribute to a better understanding of the technical and functional characteristics of avatars and their potential applications in contemporary digital design.*

Keywords*: digital avatar, avatar classification, personalization, user, fashion, gaming, virtual environments.*

Objectives. The digital avatar represents a form of personal representation in a digital environment, used for communication, interaction, or participation in virtual activities. In a chapter published in *The Oxford Handbook of Media Psychology*, an avatar is defined as a mediated representation of the self, controlled by the user during dynamic interactions [1]. This approach highlights two essential aspects: the relationship between the avatar and the person it represents, and the control exercised by the user over the avatar.

From a technical perspective, an avatar can take various forms, ranging from a two-dimensional icon or a stylized character to a realistic three-dimensional model. Its characteristics may include body shape, facial appearance, texture, movement, and expressiveness, depending on the technology employed and the intended design purpose. This paper aims to analyse and classify digital avatars according to their creation methods, degree of realism, customization possibilities, and areas of application. It highlights their specific characteristics in gaming, the fashion industry, and virtual environments, while also establishing a conceptual distinction between the digital avatar, the three-dimensional character, and the virtual human.

Methodology. The research methodology is based on the analysis and synthesis of specialized scientific literature concerning the concept, characteristics, and classification of digital avatars. Scientific articles and academic publications addressing two-dimensional and three-dimensional digital representations, creation

and customization methods, and their areas of application were examined. The study employs a comparative method to identify similarities and differences between the digital avatar, the three-dimensional character, and the virtual human. Based on the identified criteria, the different types of avatars are systematized, with particular emphasis on their use in gaming, the fashion industry, and virtual environments.

Research results. Digital avatars constitute a category of representations created or adapted for use in digital environments, serving functions that range from user identification to social interaction, entertainment, and product presentation. To highlight the diversity of digital avatars, they can be analysed according to several criteria that reflect the characteristics of their visual representation and creation methods, as well as their functionality, degree of customization, and areas of application (table 1).

Table 1 – **Classification criteria for digital avatars**

Classification criterion	**Types of avatars**
Form of representation	2D, 3D
Degree of realism	Abstract, stylized, semi-realistic, photorealistic
Area of application	Gaming, communication, education, fashion, marketing
Creation method	Manual modeling, parametric templates, 3D scanning, image-based reconstruction, AI generation, hybrid methods
Control method	User-controlled, predefined animation, motion capture, AI algorithms, mixed control
Degree of interactivity	Static, animated, interactive, conversational
Customization options	Appearance, body, face, clothing, movement, expressions
Relationship to the represented person	Self-representation, idealized representation, representation of a real person, fictional character
Human likeness	Non-human, anthropomorphic, realistic human
Usage environment	Web, 3D games, augmented reality (AR), virtual reality (VR), metaverse
Technical complexity	Simplified model, detailed model, articulated model, model with facial expressions and animation, model integrated with garment simulation

The classification presented in Table 1 highlights the multidimensional nature of digital avatars. They cannot be categorized exclusively according to their field of application or visual appearance, as their development involves a combination of visual, technical, and functional characteristics. Consequently, the same avatar may simultaneously belong to several categories, depending on the criterion being considered. For example, a three-dimensional human avatar used to present a fashion collection may be photorealistic, created through parametric modeling or image-based reconstruction, controlled through animation, and integrated into a virtual try-on system.

The first criterion, form of representation, distinguishes two-dimensional (2D) avatars from three-dimensional (3D) avatars. 2D avatars are represented by images, illustrations, or graphic elements and are frequently used in user profiles, games featuring two-dimensional graphics, and digital communication. 3D avatars are constructed by representing the volume and geometry of an object or character, allowing it to be examined from different angles, repositioned, and integrated into virtual environments. In the fashion industry, three-dimensional representation is of particular interest because it allows avatars to be associated with digital garments and these garments to be examined from multiple perspectives.

The second criterion, degree of realism, refers to the extent to which an avatar's appearance reproduces or interprets the characteristics of a human body or an imaginary character. Abstract avatars use simplified forms, whereas stylized avatars emphasize specific visual features without attempting to reproduce anatomy precisely. Semi-realistic avatars combine proportions and details inspired by reality with artistic elements, while photorealistic avatars aim to reproduce a person's appearance as faithfully as possible, including skin, hair, textures, and facial expressions. The choice of realism level depends on the purpose of the design. In gaming, stylization can contribute to a character's visual identity, whereas the commercial presentation of garments may require a high degree of realism to highlight material properties and garment appearance. However, visual realism does not automatically guarantee accurate body proportions or garment simulation.

Field of application is a functional criterion that distinguishes avatars according to the activities for which they were designed. In gaming, an avatar may represent a character controlled by the player, participate in virtual activities, and be modified according to the game's mechanics. In digital communication, it may serve as a visual representation of the user on social platforms or in virtual spaces. In education, avatars can illustrate processes, simulate situations, and facilitate user interaction. In marketing, they are used to promote products, present brand identities, and develop digital campaigns. In fashion, their functions include presenting collections, visualizing garments, and enabling virtual try-on. These fields are not mutually exclusive: an avatar may be used simultaneously for entertainment, communication, and garment presentation, provided that its technical structure and available functions support these uses [2, 4].

Creation method constitutes a technological criterion because it describes the procedures used to produce a digital avatar. Manual modeling involves constructing the form through the designer's direct intervention, providing control over geometry, proportions, and details. Parametric templates allow the model to be modified by adjusting predefined values, such as height, body measurements, or

facial proportions. Three-dimensional scanning facilitates the acquisition of the geometry of a real person, while image-based reconstruction aims to estimate shape and appearance from photographs or video sequences. Artificial intelligence-based generation enables digital representations to be created or transformed using prompts, images, or input data. Hybrid methods combine two or more procedures, for example, automated reconstruction followed by manual correction. The reviewed literature confirms the diversity of these approaches and highlights the importance of controlling the model's appearance and movement [2, 3].

Control method describes how an avatar's position, movement, and behavior are determined. User-controlled movement is characteristic of video games and interactive environments, where commands modify a character's actions. Predefined animation involves the use of previously created movement sequences, such as walking, turning, or changing position. Motion capture enables the movements of a real person to be transferred to a digital model, while artificial intelligence algorithms can contribute to the generation of movements, expressions, and behaviors. Hybrid control combines these mechanisms. In fashion, the choice of method influences how garments can be observed in different positions and during movement. Predefined animations may be sufficient for presenting a collection, whereas analyzing garment behavior in motion may require motion capture and three-dimensional simulation [2, 4].

The criterion of degree of interactivity distinguishes static, animated, interactive, and conversational avatars. A static avatar provides a visual representation without autonomous changes in position or behavior. An animated avatar displays predefined movements without necessarily requiring user intervention. An interactive avatar responds to commands and allows certain characteristics or actions to be modified, whereas a conversational avatar can communicate through text or voice using language-processing technologies and artificial intelligence. These categories describe distinct functions that can be combined within the same system. For example, an avatar designed for e-commerce may allow users to select garments, rotate the model, change outfits, and obtain answers to questions about products [4].

Customization capabilities refer to the characteristics that can be modified after an avatar has been created. These may include overall appearance, body shape, facial features, hairstyle, clothing, expressions, and movements. In gaming, customization contributes to character individualization and increases user engagement in the virtual environment. In fashion, it can serve both an aesthetic and a practical purpose, as modifying body proportions makes it possible to examine how garments are represented on different body types. However, visual

customization should not be confused with the technical accuracy of simulation: an avatar may resemble a person without accurately reproducing their body measurements or the behavior of textile materials.

The criterion of relationship to the represented person distinguishes avatars that reproduce the user, idealized versions of the user, representations of real individuals, and fictional characters. Self-representation aims to reproduce the user's identity, whereas idealized representation allows deliberate modifications to appearance. Avatars associated with real individuals may be used in communication, entertainment, or commercial campaigns, subject to respect for image rights. Fictional characters are designed without the requirement to reproduce a specific person. This distinction is important for establishing the design purpose and the required degree of fidelity.

Human likeness represents a complementary criterion to the degree of realism. Non-human avatars may take the form of abstract entities, animals, or personified objects; anthropomorphic avatars incorporate certain human characteristics, while realistic human avatars reproduce the anatomy and appearance of the human body. An anthropomorphic character may be highly detailed without becoming photorealistic. Therefore, human likeness and realism should be analyzed separately because they describe different aspects of representation.

Usage environment indicates the digital space in which an avatar is integrated, such as web platforms, 3D games, augmented reality (AR), virtual reality (VR), or the metaverse. The environment influences interaction, the level of detail, and technical requirements. For example, an avatar intended for a web page may need to be optimized for fast loading, whereas an avatar used in VR must support examination within a three-dimensional space. In AR, the digital representation is superimposed on the real environment, potentially facilitating the observation of products in their intended context of use.

The final criterion, technical complexity, summarizes the level of development of the digital model. A simplified model contains relatively few details and may be sufficient for stylized representations. Detailed models incorporate more complex geometry and textures. Rigged models allow body segments to move, while models featuring facial expressions and animation reproduce facial and bodily changes. Models integrated with garment simulation enable digital garments to be associated with the avatar and their visual behavior to be examined. Complexity must be considered in relation to the application's purpose, as a higher technical level does not automatically represent the best solution. For a game character, animation fluidity may be the priority, whereas

digital garment design requires compatibility between the body model and the garment, accurate geometry, and high-quality simulation.

Overall, the criteria presented in Table 1 form an analytical framework that enables digital avatars to be described from complementary perspectives. The main finding is that a digital avatar should be analyzed as a combination of visual representation, creation method, functionality, and usage context rather than as a category defined by a single characteristic. This approach is particularly relevant to fashion, where the same avatar may simultaneously serve as an aesthetic representation, a medium for product presentation, and a body model for garment visualization or simulation.

Conclusion. The literature review highlights the diversity of digital avatars and the need to evaluate them using complementary criteria. The creation method, degree of realism, customization capabilities, and representational function determine their potential applications in gaming and the fashion industry. The distinction between an avatar, a 3D character, and a virtual human should be made according to the role and behavior of the representation, as these categories may overlap. In fashion, integrating avatars with garment modeling and simulation extends their use beyond visual presentation to virtual product try-on. The proposed classification provides an analytical framework for characterizing these representations in digital design.

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