Digital Humans Report

# 1.Introduction to Digital Humans

The definition of Digital Humans(also known as virtual humans) on wikipedia is a software fictional character or human being.

In the early 20th century, it was William Fetter(Print Magazine, XX:VI，1966）, a Boeing art director who first drew a human figure using a computer device and that figure was known as the "Boeing Man", widely recognized as the first Digital Human in history. Later, as computer technology developed, Digital Humans became more and more modern.

Currently, there are basically two types of Digital Humans, Avatars and Autonomous Virtual Humans.

Avatar represents the users’ figure and action graphically.They have been very popular since many online works and movies, like the Palace, Second Life, The Avatar.

An autonomous virtual human is an autonomous agent with embodiment or an embodied agent. It is basically a mask and a man hidden under the mask, which covers the appearance of the man.

## 1.1Application of Digital Humans

Virtual humans have been created as tools as well as artificial companions in many areas, like film production, video games, military simulation, medical simulation, clothing industry, and so on.

For example, in the clothing industry(Emmanuel S.S, & Francesca B, 2022), designers can use digital humans to simulate many people with different shapes, so that they can customize different clothes for them.

On the other side, film producers use this technology to create great movies where people who even didn’t exist can perform well in the movie(Carolyn Giardina, 2017).

## 1.2Potential Impact

The impact of digital humans isn't fixed in the present(Exr consultancy Services, 2023). There are many possibilities for blurring the line between real human and digital humans, with the collaboration of humans and computers, many new industries can rise.

As technology develops, some companies can make digital humans react in a very short time, and display real-time animation to interact with the virtual world. For example, people can talk to digital humans and they can not only reply to the talk, but also have an appearance on their digital face.

2.Market Analysis

The digital human avatar market, valued at $4.83 billion in 2022, is anticipated to soar to $67.54 billion by 2032, propelled by the shift to remote work and distance learning during the COVID-19 pandemic and the rise of the gaming industry. The integration of the metaverse across various sectors, including commercial, healthcare, automotive, and retail, has further spurred this growth. The United States, leveraging advanced technologies like AI, machine learning, and AR, leads this expansion. Innovations and a robust ICT infrastructure enable quicker adoption of digital human avatars, although research and development costs remain a challenge(The Brainy Insights, 2023).

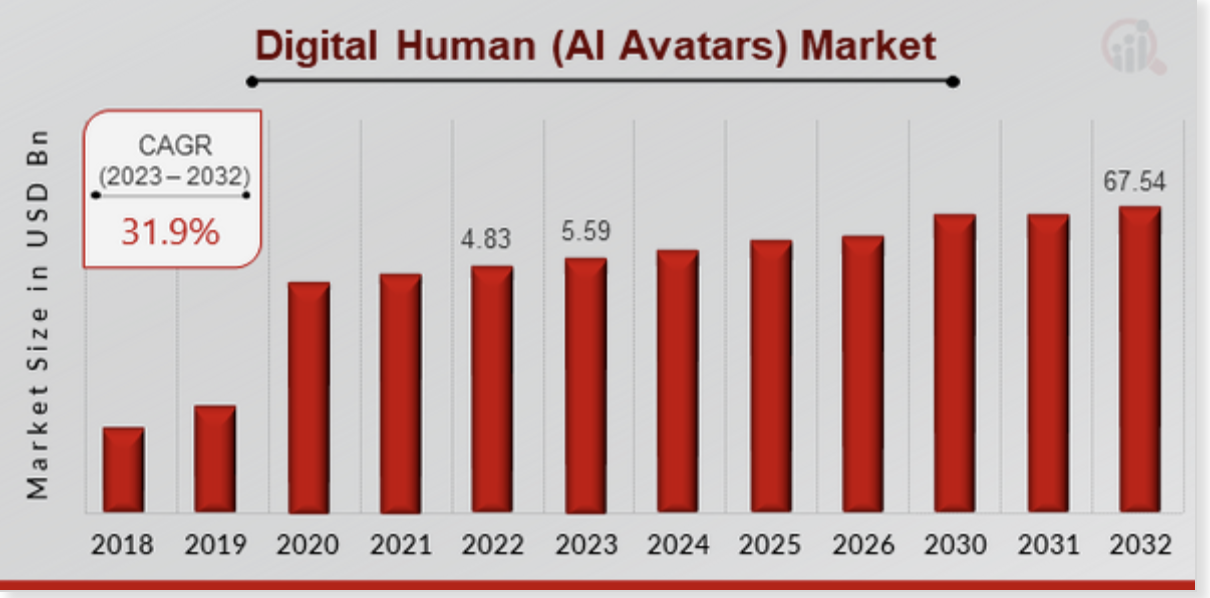


FIGURE 1: DIGITAL HUMAN (AI AVATARS) MARKET SIZE 2018-2032 (USD BILLION)

**3.Innovation Concepts of Digital Human**

**3.1Dominant Design**

In the "Digital Humans" sector, the push towards a dominant design involves melding AI realism (like natural language and emotional intelligence) with user-friendly aspects (ease of use, ethics, cost). This path includes standardizing key technologies for broader application and effectiveness.

Abernathy and Utterback's innovation model suggests that after initial innovation bursts, industries tend towards a dominant design, shifting focus from invention to improving processes and cost efficiency. This is applicable to Digital Humans, where after a period of varied technological exploration, a dominant design emerges, leading companies to refine rather than innovate from scratch.

References such as "The Design of Design" (Gordon, 1976) and "Innovation and Inertia" (Anderson and Tushman, 1990), along with Christensen's insights on disruptive technologies (1997), highlight the evolutionary path of technological cycles towards dominant designs, emphasizing the necessity of aligning technology with market demands in the digital human domain. Ferràs-Hernández, Nylund, and Brem (2023) highlight that business model innovation is as crucial as technological advancements in establishing a dominant design in AI, especially for digital humans. This reinforces AI's role as a service, blending tech and business model innovations.

**3.2Disruptive innovation**

**In terms of Low-End Disruption**, it holds cost advantages in entertainment media, fashion apparel design, education, and other fields. It can assist in cost savings by partially replacing human resources to some extent. Taking fashion apparel design as an example, designers can observe the suitability of clothing by adjusting the digital human's body shape and size online, without the high cost of hiring various models for fitting. (Silva & Bonetti, 2021)

**In terms of New Market Disruption**, it meets the needs of healthcare, product design, and other fields. It can provide a virtual body to accomplish tasks that real humans cannot or should not do. Through digital humans, scientists can be assisted in research in the field of human anatomy, and it can also provide powerful ergonomic design tools for some designers. (Chaffini, 2005)

**In terms of impacting the value chain**, digital human has changed the traditional utilization of human resources. With its low-cost and highly adaptable characteristics, it replaces human labor to perform tasks. EC Sung et al. (2022) pointed out the feasibility of digital human replacing traditional human resources in their article, highlighting its ability to quickly occupy vacancies in the experience economy market, where traditional human resources require significant training time and costs.

**3.3Diffusion**

Diffusion, in the context of IT innovation, is the dissemination of a new technology or idea inside a society or between societies. This process include not only the dissemination of technology, but also the assimilation and modification by users.(Stoneman & Battisti, 2010) The Adoption Life Cycle of the Digital Human, a notion intimately linked to the dissemination of innovations, demonstrates the varying stages at which different segments in a society embrace a new technology. (Gatignon & Robertson, 1989)

The cycle often commences with "Innovators," individuals who are enthusiastic about exploring novel technologies, and is then followed by "Early Adopters," who are forward-thinking individuals that recognize the potential advantages and are prepared to undertake risks. The "Early Majority" follows, consisting of pragmatic individuals who embrace the technology once its use has been demonstrated. The "Late Majority" exhibits a higher level of skepticism and refrains from adopting a technology until it has firmly established itself as a widely accepted standard. Ultimately, "Laggards" are the final group to embrace something new, typically because they are resistant to change or lack the means to do so.(Woodside & Biemans, 2005)

Smartphone adoption is an example of this tendency. Smartphones were initially welcomed by innovators for their novelty. As smartphones became more user-friendly and essential for daily life, both the early and late majority adopted them. Early adopters saw the potential to revolutionize communication. When smartphones became unavoidable, laggards adopted them, stressing digital technology distribution and adoption.

**Reference**:

1. *Print Magazine*, XX:VI（1966）William Fetter: *Computer Graphics at Boeing.*
2. Emmanuel S.S, & Francesca B, (2022),*Digital humans in fashion: Will consumers interact?*Journal of Retailing and Consumer Services Volume 60 <https://www.sciencedirect.com/science/article/abs/pii/S0969698920314375>
3. Carolyn Giardina, (2017), *How Artificial Intelligence Will Make Digital Humans Hollywood’s New Stars*, The Hollywood Reporter. <https://www.hollywoodreporter.com/movies/movie-news/how-artificial-intelligence-will-make-digital-humans-hollywoods-new-stars-1031553/>
4. Exr consultancy Services, (2023), *Real-Life Impact Of Digital Humans Today,* Medium. <https://medium.com/@niranjan.exr1/real-life-impact-of-digital-humans-today-f7a8aa8216d>
5. Abernathy, W.J., & Utterback, J.M. (1978). Patterns of Industrial Innovation. Technology Review, 80(7), 40-47.
6. Anderson, P., & Tushman, M.L. (1990). Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. Administrative Science Quarterly, 35(4), 604-633.
7. Christensen, C.M. (1997). The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Boston, MA: Harvard Business School Press.
8. Gordon, W.J.J. (1976). The Metaphorical Way of Learning and Knowing. Cambridge, MA: Porpoise Books.
9. Gatignon, H., & Robertson, T. S. (1989). Diffusion of innovation. European Institute For Advanced Studies In Management.
10. Stoneman, P., & Battisti, G. (2010, January 1). Chapter 17 - The Diffusion of New Technology (B. H. Hall & N. Rosenberg, Eds.). ScienceDirect; North-Holland. <https://www.sciencedirect.com/science/article/pii/S0169721810020010?casa_token=9o-wiJGNgD0AAAAA:6KmTM8_yXtAs8s-2Dy4wq9ZjHjkryqtBO4ixaxvj83RFXakZ2fJLW7cX0n5bY3I7y0RZGYOfbg>
11. Woodside, A. G., & Biemans, W. G. (2005). Modeling innovation, manufacturing, diffusion and adoption/rejection processes. Journal of Business & Industrial Marketing, 20(7), 380–393. <https://doi.org/10.1108/08858620510628614>
12. Silva, E. S., & Bonetti, F. (2021). Digital humans in fashion: Will consumers interact?. Journal of Retailing and Consumer Services, 60, 102430. <https://www.sciencedirect.com/science/article/abs/pii/S0969698920314375>
13. Chaffin, D. B. (2005). Improving digital human modelling for proactive ergonomics in design. *Ergonomics*, *48*(5), 478-491. <https://www.tandfonline.com/doi/abs/10.1080/00140130400029191>
14. Sung, E. C., Han, D. I. D., Bae, S., & Kwon, O. (2022). What drives technology-enhanced storytelling immersion? The role of digital humans. *Computers in Human Behavior*, *132*, 107246. <https://www.sciencedirect.com/science/article/abs/pii/S0747563222000681>
15. Ferràs-Hernández, X., Nylund, P.A., & Brem, A. (2023). The Emergence of Dominant Designs in Artificial Intelligence. *California Management Review*.