

# Fashion as the Future Computing

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## ABSTRACT

This paper presents a theoretical and critical analysis of the current state of digital technologies in fashion, hypothesizing that fashion represents the future of computing as society transitions to screenless, wearable technologies. It revisits the last forty years of technological advances in wearable technology, tracing the evolution through Web 1.0, 2.0, and 3.0, to establish a scenario where the next stage of human-machine interaction is driven by sensory experiences rather than screen-oriented devices. In this context, fashion emerges as a crucial medium for technology, shaping future user interfaces. From the integration of the IoT with clothing to recent prototypes of AI wearable assistants like Human AI Pin and Rabbit, this paper explores the cyborg culture where humanity merges with machines through fashion. It also highlights the intersection of fashion and digital technology, emphasizing the pivotal role designers will play in this innovative landscape and the transformation of the human body. The paper is structured around four main pillars: history of automation in creative processes, drawing on Walter Benjamin's perspectives and comparing the first industrial revolution with the current era of Artificial Intelligence-driven automation; cyborg culture as discussed by Donna Haraway and Michel Foucault, examining the progression of wearable technologies and their impact on human cognitive abilities and the relationship with the body; immersive experiences offered by fashion and their role in shaping collective identities, supported by the works of authors like Zygmunt Bauman, Pierre Lévy, and Shoshana Zuboff, consolidating the discussion, presenting the concept of "Fashion as Future Computing,"

**Keywords:** fashion, IoT, cyborg, artificial intelligence, wearable technology, transhumanism.

## INTRODUCTION

As Walter Benjamin proposes (1936), with mechanical reproduction the creative process and its value changed. Benjamin argued that mechanical reproduction diminishes the aura of the original artwork, and as a result, the relationship between the artwork and the viewer is altered, leading to a new mode of perception. But in the digital era we can question some of these affirmations, because the digital spectrum opens new possibilities for fashion, arts and creative industries. Beyond being the medium, the digital is also the message. While automation can streamline production

processes and open up new possibilities for creativity, it also raises questions about the role of human agency and the nature of artistic expression - in the light of what Benjamin proposes. The author helps us relate the past, present and future by bringing a critical perspective over the automation process.

Innovations like the spinning jenny, power loom, and sewing machine revolutionized production, increasing speed and efficiency, and making clothing more accessible. The factory system further reduced costs, accelerated production, and popularized fashion trends. However, these advancements came with downsides, such as poor working conditions, low wages, and unsustainable practices tied to mass production. Decades later, similar concerns came with the digital revolution. The early 2000s marked a shift, with microcomputing and the Internet of Things (IoT) shaping today's interconnected world. The IoT emerged with devices like the iPhone (2007), blending mobile and internet capabilities, while wireless sensor networks and RFID technology transformed data collection and supply chain management. The evolution of the web transformed fashion and other industries. The Web 1.0 introduced online commerce, enabling brands to reach broader audiences and sell globally; the Web 2.0 empowered consumers through social media and user-generated content, establishing new economic models and communication strategies. And now we see the rise of the Web 3.0 (still work in progress) with blockchain technology, ensuring supply chain transparency and reducing counterfeiting, while NFTs enable unique, collectible digital fashion. AI-powered design tools are also part of this new era where virtual and augmented reality are creating immersive shopping experiences, reshaping the future of fashion.

All of those advancements result from a continuous process of experimentation with wearable technologies, started a while back ago. Among them, the Google Glass, a pioneering wearable technology, aimed to revolutionize the way we interact with information and the world around us. Launched in 2013, these smart glasses featured a tiny display that projected information directly into the wearer's field of vision. Users could access information, send messages, and take photos and videos hands-free, use voice commands, and control various functions using natural language. Although pioneering, Google Glass faced several challenges, including privacy concerns, social stigma, and technical limitations. The device's bulky design and limited battery life made adoption difficult. But in 2023 and 2024 we see the comeback of such devices with Apple Vision Pro and Meta Orien launches, bringing back the whole discussion of wearable technologies for mixed reality experiences.

While still relatively considered a taboo, we can observe that since the birth of Google Glass, the acceptance of wearable technologies has increased. Meta Quest 2 sold approximately 1.113 million units in Q4 2022<sup>1</sup>, and Meta Quest 3 is estimated to have

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<sup>1</sup> <https://arinsider.co/2023/02/06/how-many-vr-headsets-did-meta-sell-in->

sold at least 1 million units within the first eight months after launch<sup>2</sup>. Today's adoption rate of wearable devices, especially smartwatches and fitness trackers, has seen significant growth in recent years, with approximately 454.69 million individuals worldwide using smartwatches, marking a 41% increase from 323.99 million users in 2023<sup>3</sup>. While the general public's acceptance of smart glasses remains cautious, the technology continues to evolve. As manufacturers address privacy concerns, improve battery life, and refine designs, we may see a gradual increase in consumer adoption in the near future, with around 171 million people worldwide<sup>4</sup> having experienced virtual reality technology<sup>1</sup> till date. This growth is driven by factors like increasing demand for gaming consoles, extensive application in sectors such as retail and manufacturing, and the potential for use in medical training, industrial prototyping, and education<sup>4</sup>.

While smart glasses haven't achieved the same level of mainstream adoption as VR headsets, they continue to evolve. Google Glass, an early pioneer, faced challenges related to privacy concerns, design, and battery life. However, recent advancements and a focus on enterprise applications have shown promise. As main leaders in that space, Apple's Vision Pro, unveiled in June 2023, marks a significant leap in wearable technology. Also, Meta Orion is a significant step forward in augmented reality (AR) technology, unveiled at Meta Connect 2024. This device offers an immersive experience that seamlessly blends the physical and digital worlds, incorporating eye and hand tracking, enabling intuitive interaction with digital content in real time.

Thus, we observe more natural ergonomics and humanized user interfaces, even in simple products like the partnership between Meta x RayBan stylish pair of smart glasses. These glasses blend iconic Ray-Ban design with cutting-edge technology, allowing users to capture photos and videos, make calls, and listen to music hands-free. The glasses feature built-in cameras, open-ear audio, and easy social sharing capabilities, representing a significant step towards integrating smart technology into everyday fashion, offering a more discreet and stylish way to stay connected.

But there is one caveat on devices as such: the surveillance power integrated into them. This is the same reason that challenged the launch of Google Glass many years ago. Data ownership is one of the biggest struggles in the tech space, where monopoly and lack of transparency take over the innovation aspect of these products. On that matter, Michel Foucault (1987 apud FORNET-BETANCOURT, 1987) discusses the concept of the panopticon, very relevant to this discussion. He points to this system of surveillance from a permanent record, where the position of everything and everyone is known. Based on this hierarchical and continuous figure proposed by the

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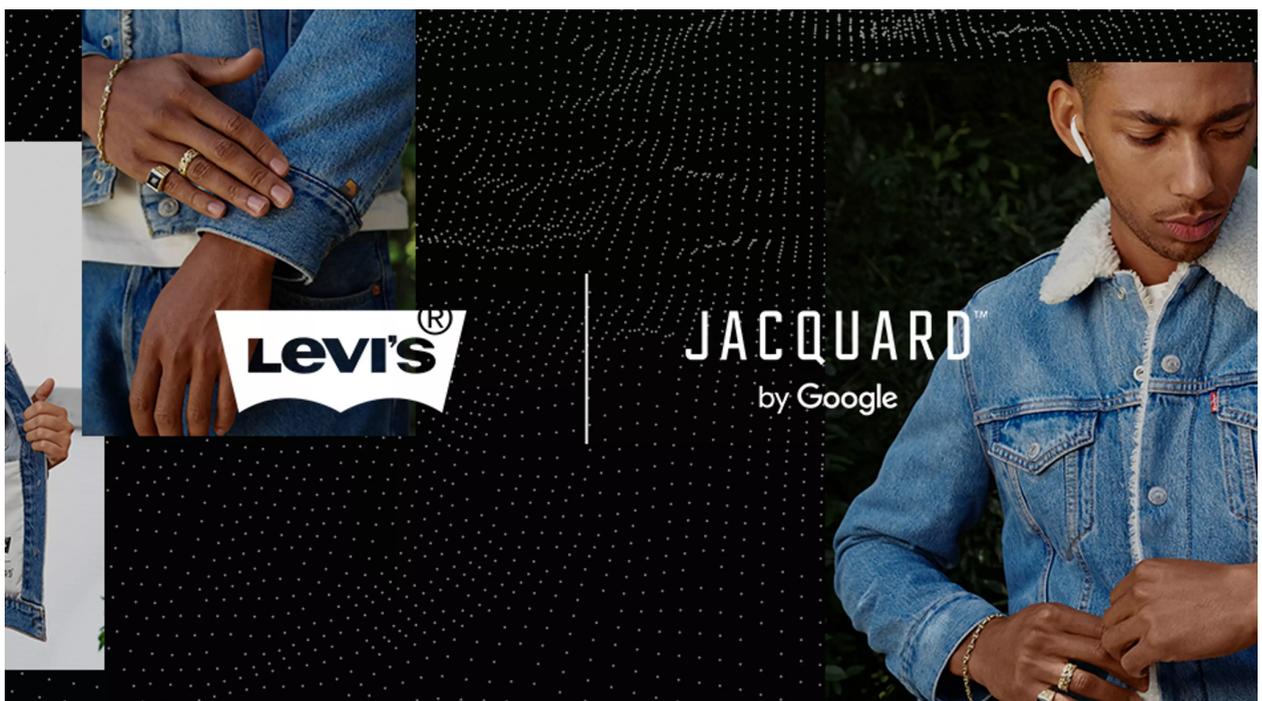
<sup>2</sup> [https://www.uploadvr.com/quest-3-sold-at-least-1-million-units/?utm\\_source=chatgpt.com](https://www.uploadvr.com/quest-3-sold-at-least-1-million-units/?utm_source=chatgpt.com)

<sup>3</sup> [https://www.demandsage.com/smartwatch-statistics/?utm\\_source=chatgpt.com](https://www.demandsage.com/smartwatch-statistics/?utm_source=chatgpt.com)

<sup>4</sup> As per G2 latest report.

author, it is possible to think about the operating modes of digital surveillance, directly linked to the free granting of personal information, according to an anti-panoptic system. And with wearable technology not only the panopticon comes to life, but it evolves into another Foucault's concept: the synopticon, where there is a regime of control established through mobile devices, in a distributed power of surveillance. This is why the ethical discussion is crucial when it comes to ubiquitous and invasive wearable technology, making us think about the responsibilities of the fashion industry when collaborating with such companies as such, and their future liability when it comes to playing a role of fashion as a computational interface.

But fashion innovation is not limited to computing vision. It goes beyond when it comes to sensorial and textile innovation happening in the last two decades. When it comes to material innovation, Google/Levi's Project Jacquard is a reference. The Levi's Commuter Trucker Jacket with Jacquard by Google is a prime example of how technology can seamlessly integrate with fashion. This innovative jacket, released in 2017, featured conductive threads woven into the sleeve cuff, allowing users to control their smartphones with simple gestures. With a tap or swipe, users can perform actions like answering calls, playing music, and receiving notifications without ever taking their phone out of their pocket. By embedding conductive threads into fabric, Jacquard opens up a world of possibilities for wearable technology, where clothing can become a functional extension of our digital lives.



[https://www.levi.com/US/en\\_US/blog/article/levi-s-trucker-jacket-with-jacquard-by-google](https://www.levi.com/US/en_US/blog/article/levi-s-trucker-jacket-with-jacquard-by-google)

But they were not alone. Simultaneously there was also Transformative Clothing research, carried out at the MIT Media Lab's Tangible Media Group pushing the

boundaries of wearable technology. Their groundbreaking research in transformative clothing, bioLogic, explored the intersection of biology and technology to create living, breathing textiles.



MIT bioLogic - <https://morphingmatter.org/projects/biologic>

This revolutionary approach to textile design has the potential to revolutionize the fashion industry and create garments that are both functional and aesthetically pleasing. Back in 2010's another exciting area of research at the MIT Media Lab was the development of shape-shifting garments. By incorporating advanced materials and innovative design techniques, researchers are creating clothing that can morph and adapt to different situations. Imagine a jacket that can transform into a coat or a dress that can adjust its fit to the wearer's body.

Later on we see the impact of these researches in a prototype that brought back to life the dream of interacting with smart fabrics: Adobe's Project Primrose. Adobe's Project Primrose went viral, because it was a very tactile innovative project in the middle of the hype of digital fashion. The project showcased a digital dress that could dynamically change its patterns and designs in real-time. At the heart of Project Primrose lies a complex interplay of technology and artistry composed by a web of programmable light-diffusing petals, each capable of independently changing color and intensity. This technology, coupled with advanced algorithms, allows for the creation of dynamic and ever-changing patterns.. By blurring the lines between the physical and digital realms, it offers a glimpse into a future where fashion and technology are seamlessly integrated.



<https://www.youtube.com/watch?v=EvGquKkSFMM>

And when it comes to new materials, there is a recent case study that emerged bringing a completely new technology for traceability using digital printed codes directly on the surface of fabrics. The South America company R-Inove<sup>5</sup> developed a technology where binary information can be printed and read with an ultraviolet device directly on the surface of threads, making possible whole garments to carry digital information, certification and traceability (which can be implemented inside blockchain if necessary) without any need of battery or electronics. When it comes to the micro computing integration to garments, like Jacquard Project and Primrose Dress, the general concern is that such pieces will carry additional electronic components disposed of in nature, decreasing their sustainability. But it R-INOVE the fabric becomes the carrier of the binary information making the traceability process smarter and cleaner. Although we will not deep dive in the DPP topic, it is important to mention that the rise of new legislation around the Digital Product Passport<sup>6</sup> in the European Union opens the precedent for technologies like R-INOVE, replacing the traditional RFID chips that carry certificates and traceable data.

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<sup>5</sup> [https://r-inove.com/?page\\_id=165&lang=en](https://r-inove.com/?page_id=165&lang=en)

<sup>6</sup> <https://data.europa.eu/en/news-events/news/eus-digital-product-passport-advancing-transparency-and-sustainability>



[https://r-inove.com/?page\\_id=165&lang=en](https://r-inove.com/?page_id=165&lang=en)

The conclusion is that by harnessing the power of biomaterials, researchers are developing fabrics that can adapt to their wearer's needs, such as regulating body temperature or changing shape in response to environmental stimuli. Projects like the ones listed above are true pioneers, putting at test new user interfaces and usability of commands and computational capabilities. They also open up for a crucial social and anthropological debate: the merge of machines and humans, as technology becomes smaller, more wearable and integrated. If we reach this frontier, Fashion will be created for hybrid beings - so called Cyborgs - and it will play an essential role in the computational market.

## **THE CYBORG CONDITION: REDEFINING HUMAN BOUNDARIES AND FUTURE OF FASHION**

“I would rather be a cyborg than a goddess”  
(Donna Haraway, 1985)

The wearable technologies move from external devices to intrinsic intelligent fabrics, possibly powered and integrated with artificial intelligent systems in the future. So, how does this impact our own body materiality and consciousness? Will fashion contribute to this process of exchange between synthetic and biological? Donna Haraway's "A Cyborg Manifesto" offers a powerful framework for understanding the implications of wearable technology. By blurring the lines between the human body and technology, wearable devices embody the cyborg ideal. They extend our sensory capabilities, augment our cognitive functions, and challenge traditional notions of the self.

Haraway argues that the cyborg is a powerful metaphor for understanding our increasingly technological world. By embracing the term “cyborg”, she suggests, we can dismantle oppressive power structures and create new possibilities for social and political change. The cyborg, she presents, is a creature of both fiction and reality, a product of scientific and technological advancements. Through the cyborg, Haraway challenges the binary oppositions that have shaped Western culture, such as nature versus culture, male versus female, and human versus machine. She proposes a more fluid and interconnected understanding of identity, one that embraces hybridity and multiplicity - an approach that also dialogues with the current state of society where life, emotions and relationships are liquid/fluid (BAUMAN, 2000). Now, it may be the time to revisit such discussions, in an era where the presence of the body exists between physical <> digital, and younger generations (Gen Z and Alphas) have identities spread across metaverses and the physical world.

The merger of humans and machines starts in our minds, representing a profound philosophical and technological frontier, critically examined by pioneering artists and theorists who challenge the fundamental distinctions between biological and technological entities. Artists like Stelarc and ORLAN have been instrumental in pushing the boundaries of human corporeality, transforming the body into a site of technological intervention and exploration. Their work can be key to redefine also the functions of fashion as a computing interface in the near future.

### **Stelarc, Orlan and Neuralink: The Body as Performance Interface**

Stelarc, an Australian performance artist, is renowned for his groundbreaking work exploring the intersection of technology and the human body. His performances and installations often involve augmenting the human body with technological implants and prosthetics. Stelarc's work challenges traditional notions of the body and its limitations. He uses technology to extend the body's sensory and motor capabilities, blurring the lines between the organic and the artificial. His performances often involve invasive procedures, such as implanting third ears or robotic limbs, pushing the boundaries of human augmentation.



<https://news.artnet.com/art-world/artist-stelarc-grows-third-ear-324745>

Through his provocative work, Stelarc raises important questions about the nature of the body, identity, and the future of human-machine interaction. His work, including suspended performances and prosthetic extensions, demonstrates the body as an obsolete, programmable system that can be augmented, extended, and redesigned. Key projects like his "Third Hand" and "Ear on Arm" challenge traditional notions of bodily integrity, presenting the human form as a malleable technological platform. A second key name to think about the status of the body is Orlan, a French performance artist, is known for her provocative and often controversial work that explores the boundaries of the body and identity.

Her performances often involve surgical interventions and body modifications, blurring the lines between art, technology, and the human. She challenges traditional notions of beauty and identity by subjecting her own body to a series of surgical interventions, transforming her appearance into a hybrid of historical and contemporary beauty ideals. Orlan's work aligns with the concept of the cyborg, as she uses technology and medical procedures to reconfigure her body. Her performances often involve live surgery, where she invites the audience to participate in the transformation of her body.

And as we merge from examples like Orlan and Stelarc, the last use case to exemplify this papers' proposed hypothesis is Neuralink: a neurotechnology company founded by Elon Musk, at the forefront of developing implantable brain-machine interfaces (BMIs). These devices are designed to directly interface with the human brain, enabling communication with computers and other devices. Neuralink's ambitious goal is to decode and stimulate neural activity, potentially revolutionizing fields such as

medicine, neuroscience, and human-computer interaction: “Brain-computer interfaces have the potential to change lives for the better. We want to bring this technology from the lab into peoples' homes”<sup>7</sup>. By implanting tiny electrodes into the brain, Neuralink aims to record and interpret neural signals, allowing users to control devices with their thoughts. This technology has the potential to restore motor function in individuals with paralysis, improve cognitive abilities, and even enhance human capabilities.

However, the ethical implications of such technology, including privacy concerns and the potential for misuse, raise significant questions that must be carefully considered. Shoshana Zuboff (2015) points our attention to the privacy concerns and how data is continuously extracted from users as surveillance capitalism, a fundamental part of today' s society. Keeping in mind Zuboff's thoughts, it is crucial we look into the future of humans and machines with caution, while aiming to incorporate fashion as a solution that could be accessible, scalable and possibly safe if developed by the right corporations following ethical standards. What we face is a new horizon for humans and machines, in which the value of the bodies will shift, the same way our level of consciousness will completely change. In this process, computers will likely change with us, adapting to new forms of interaction and usability incorporating smaller shapes, blending into our daily lives.

### **Fashion: the Computing's Final Resort**

What the future holds we yet don't know. But we have a hint that since COVID-19 habits have changed and younger generations are coming with stronger ties to their digital identity. Roblox, one of the biggest social gaming platforms and heavy in fashion items has 88.9 million monthly users globally<sup>8</sup>, while Zepeto, a south korean strong fashion game platform shows an impressive number of 20 million global monthly users between the ages of 18 -35<sup>9</sup>. This shift marks a moment in history where wearable devices and virtual identities are seen in more positive lenses, with high demand for VR goggles. We also observe the appropriation of the tech space by luxury fashion brands, such as Coperni, who finds inspiration in the digital realm and continues pushing the boundaries when it comes to experimentation with electronics, while Google has possibly announced the new come back of Google Glasses with AI integration and Android XR new functionalities<sup>10</sup>.

This advance opens up the imagination on how fashion will incorporate the technologies and how it will be the main interface powering informational experiences,

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<sup>7</sup> <https://neuralink.com/>

<sup>8</sup> [https://www.statista.com/statistics/1192573/daily-active-users-global-roblox/?utm\\_source=chatgpt.com](https://www.statista.com/statistics/1192573/daily-active-users-global-roblox/?utm_source=chatgpt.com)

<sup>9</sup> [https://nwn.blogs.com/nwn/2023/02/zepeto-metaverse-platform-user-data.html?utm\\_source=chatgpt.com](https://nwn.blogs.com/nwn/2023/02/zepeto-metaverse-platform-user-data.html?utm_source=chatgpt.com)

<sup>10</sup> <https://blog.google/products/android/android-xr/>

decades from now. Each fashion piece will become an informational beacon that can hold its history, ownership, certification and traceability digitally. And the convergence of fashion and technology is propelling the industry towards a future where the boundaries between the physical and digital realms blur. The cyborg, once a concept confined to science fiction, is becoming increasingly tangible as wearable technology advances and integrates seamlessly into our everyday lives.

Adoption of mixed reality glasses still has to be seen, but the growth of AI assistants integrated to such devices will for sure increase their usability and strength among new users, offering a larger use case. The integration of artificial intelligence (AI) is clearly revolutionizing the fashion industry, with AI-powered design tools generating innovative designs, also incorporated in wearable devices like Humane AI Pin, Rabbit AI, Meta RayBan and much more. Moreover, the last horizon is the advancements in materials science and biotechnology. They are leading to the development of smart fabrics that can adapt to environmental conditions, monitor vital signs, or even change color and texture. Initiated with groundbreaking MIT and Google efforts, the convergence of fashion and technology has the potential to redefine the way we perceive and interact with clothing. As devices are smaller, lighter and faster it is likely fashion will become the next interface of digital communication and accessories will become hybrids of functionality and style.

However, as we embrace this technological revolution, it is crucial to consider the ethical implications. Issues such as privacy, sustainability, and the potential for digital inequality must be addressed to ensure that the future of fashion benefits all. Above all, the human body will face a new era, in which the relationship with technology will be humanized, ergonomical, human centered and the communication with machines will be part of our cognitive processes. The big risk is who owns the power over our bodies, as machines and humans merge. How can fashion be a powerful tool of customization and privacy, instead of being appropriated as a new tool of control? The answers are yet to be discovered, but the process points towards an interesting future where computing technologies and fashion will be the gate way to unique experiences.

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