

## Web3 Technologies in Contemporary Digital Ecosystems (Editorial)

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Web3 represents a new paradigm in the evolution of the internet, shifting from platform-centric and data-extractive models (Web2) toward decentralized, user-owned, and trust-minimized digital ecosystems. Built upon Distributed Ledger Technologies (DLT), smart contracts, cryptographic protocols, and token-based economic models, Web3 introduces new forms of value exchange, governance, and digital interaction (Swan, 2015; Buterin, 2014). At its core, Web3 seeks to reconfigure power structures on the internet by enabling peer-to-peer interactions without intermediaries, fostering transparency, immutability, programmability, and algorithmic trust.

A central pillar of Web3 is tokenization, which enables the representation of digital and physical assets through cryptocurrencies, utility tokens, and Non-Fungible Tokens (NFTs). NFTs introduce verifiable digital scarcity, provenance, and ownership, transforming how creative content, virtual assets, digital identities, and real-world assets are produced, exchanged, and preserved (Wang et al., 2021; Razi et al., 2024). These mechanisms underpin new economic and cultural ecosystems such as blockchain gaming, decentralized finance (DeFi), digital art markets, metaverse environments, and decentralized autonomous organizations (DAOs).

Beyond technological infrastructure, Web3 also represents a socio-technical transformation, influencing cultural production, creative industries, governance models, data sovereignty, and participation structures (Leible et al., 2019; Díaz et al., 2025). In scientific contexts, Web3 principles are increasingly connected to Decentralized Science (DeSci), promoting transparency, traceability, and new incentive systems for research, data sharing, and knowledge production (Wilkinson et al., 2016; Weidener & Spreckelsen, 2024).

However, despite its transformative promise, Web3 also introduces complex challenges related to security, privacy, usability, governance, regulatory compliance, software quality, and societal impact. Smart contract vulnerabilities, identity management, data protection, scalability constraints, and the maturity gap between experimental innovation and real-world deployment remain critical research questions (Singh et al., 2021; Alaba et al., 2023). In fact, Web3 today constitutes a dynamic and

multidisciplinary research field situated at the intersection of computer science, digital media, economics, law, design, and cultural studies.

This special issue of the *Journal of Digital Media & Interaction* presents a curated selection of extended and revised papers originally presented at the *WEB3: Tokenization, Technology and Culture Conference*, hosted by the University of Aveiro, Portugal. The conference brought together researchers, industry professionals, creators, and societal stakeholders interested in the technological foundations and cultural implications of tokens and Non-Fungible Tokens (NFTs). It explored both the underlying infrastructures required to support token-based systems and their broader societal, economic, and cultural impacts. The event was supported by BLOCKCHAIN.PT – the “Descentralizar Portugal com Blockchain” Agenda, funded by the PRR – Plano de Recuperação e Resiliência (NextGenerationEU), under reference 02/C05-i01.01/2022.PC644918095-00000033.

Within this context, the current issue emerges at a decisive moment to critically analyze and discuss the real impacts of Web3 technologies and their cultural ecosystems, not only in relation to public perception, but also in how they are reshaping the behaviors of creators, users, institutions, and digital artifacts themselves. The selected contributions reflect the diversity, maturity, and interdisciplinary nature of contemporary Web3 research, spanning domains such as Web3 software quality, decentralized scientific data privacy, Health Web3 cybersecurity, blockchain-based digital identity, and NFT-driven Digital Twins.

Rodrigo Antunes et al., in *A Pragmatic Approach for Web3 Software Quality Assurance Based on International Guidelines*, address one of the most pressing challenges in blockchain-based systems: ensuring software quality in decentralized environments. By translating the ISO/IEC SQuaRE framework into actionable testing practices tailored to Web3, and following a Design Science Research methodology in collaboration with the Exeedme blockchain gaming platform, the authors propose a structured quality assurance guide comprising eight testing domains, 16 subdomains, and 108 targeted tests. This work bridges the gap between theoretical quality models and the operational demands of Web3 applications, contributing to enhanced resilience, compliance, and user trust.

In *Trust, Privacy and Authenticity in Scientific Data Sharing: The Role of Blockchain and Zero Knowledge Proofs*, Joana Almeida et al. examine how blockchain technologies and Zero Knowledge Proofs (ZKP) can strengthen trust, privacy, and authenticity in Open Science and decentralized scientific data sharing. Through a systematic literature review, the authors identify key limitations in current approaches to data provenance, ownership, and privacy preservation. Framed within the emerging Decentralized Science (DeSci) paradigm, the study discusses how these technologies align with FAIR data principles and contribute to the development of secure, transparent, and privacy-preserving scientific infrastructures.

Ricardo Gomes et al., in *Threat Modeling a Health Web3 DApp*, focus on the critical security challenges of decentralized applications in the healthcare sector. Adopting a holistic threat modeling approach that integrates LINDDUN, the OWASP Smart Contract Vulnerability framework, and the Threat Dragon tool, the authors systematically identify risks across smart contracts, decentralized

identity, cross-chain interactions, and data access layers. The study demonstrates that fragmented security assessments are insufficient for healthcare contexts and proposes a hierarchical security framework in which holistic threat modeling becomes the foundation for trust, regulatory compliance, and system resilience in Health Web3 ecosystems.

In *Integration of Citizen's Card Digital Authentication in Hyperledger Fabric*, Carlos Machado Antunes et al. explore how the Portuguese Citizen's Card can be integrated into a permissioned blockchain environment to bridge traditional government-issued digital identities with Web3 infrastructures. Using the Autenticação.Gov SDK and Hyperledger Fabric, the authors demonstrate secure authentication workflows that improve accessibility and user adoption, particularly among non-expert users. The work is especially relevant for e-government services, secure voting systems, and other regulated enterprise applications, illustrating how blockchain technologies can coexist with national digital identity frameworks.

Finally, Bernardo Figueiredo et al., in *Towards a Generic NFT-Driven Digital Twin Simulation Platform: A Systematic Literature Review*, investigate the intersection of Non-Fungible Tokens (NFTs) and Digital Twin technologies. Following PRISMA guidelines, the authors analyze the current state of the art and identify a significant research gap regarding generic NFT-driven simulation platforms. The study highlights how NFT-backed Digital Twins can enable real-time monitoring, provenance tracking, predictive maintenance, and lifecycle management of assets, with applications across sectors such as manufacturing, healthcare, and livestock management, thus reinforcing the role of NFTs beyond digital collectibles and into real-world asset ecosystems.

These contributions expose key challenges related to security, trust, privacy, and interoperability, while showcasing the relevance of interdisciplinary approaches for the sustainable development of Web3 ecosystems. By bridging technological, social, and cultural perspectives, this issue contributes to a critical understanding of how decentralization and tokenization are shaping contemporary digital infrastructures.

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