E- Journal of Academic Innovation and Research in Intellectual Property Assets
(E-JAIRIPA)
Vol. V (ISSUE II) JULY - DEC 2024, pg. 73 - 94

INTERPRETING DIGITAL OWNERSHIP & INTELLECTUAL PROPERTY PROTECTION FOR AI-GENERATED CONTENT AND BLOCKCHAIN-ENABLED DIGITAL ASSETS IN CYBERSPACE

Aranya Nath[1] *& Gautami Chakravarty*[2]

Abstract

Cyberspace records ownership through connections between Artificial Intelligence blockchain systems and IP standards. AI will create significant content that demands new methods to determine who owns and created original material. The blockchain supports ownership of digital assets, particularly NFTs and rights management systems that provide improved methods to verify and protect these assets. This research finds difficulties when protecting AI-generated products while keeping blockchain assets under present legal standards. The study examines digital work protection systems through copyrights, patents, and trademarks and analyses decentralised smart contract verification and management. It finds regulatory issues and provides solution paths to update digital regulation standards. This study examines IP rights for AI and blockchain technology to suggest ways to update them.

Keywords: Intellectual Property Rights (IPR), AI-Generated Content Protection, Blockchain, Digital Ownership, Non-Fungible Tokens (NFTs), Smart Contracts and IP Enforcement

Introduction

The protection of intellectual property rights demands heightened importance in present times when the digital age meets rapid technological advances. Indian creative and inventive work requires powerful protective measures to safeguard their rights. The distributed and unalterable database characteristics in blockchain technology promise to reshape intellectual property management and protection processes. Through blockchain technology, several problems faced by Indian artists and innovators can be solved because it enables them to validate ownership claims and grant licenses while enforcing infringements. This paper examines the potential of blockchain technology to

[1] Ph.D Scholar Damodaram Sanjivayya National Law University Visakhapatnam.
[2] LLM (IPR) National Law University Judicial Academy Assam.

protect intellectual property rights in India through an assessment of its properties and advantages, disadvantages and prospects for Indian artists.

Some intellectual property rights can successfully be protected because blockchain combines three essential elements: unalterable nature, decentralised structure, and token issuance features. Since blockchain technology maintains an unalterable state, it provides a consistent system for production and proprietorship traditions. The ownership establishment protects intellectual property rights because it protects the owner. A smart contract built on blockchain delivers two functions, including enhanced security work licensing and royalty collection services.[3]

Examining AI and Blockchain in the Digital Ecosystem

AI, blockchain technology, has brought sudden and extraordinary progress to the new digital environment for managing content creation and ownership protection. AI started with basic automation and now generates artistic content that includes texts, music, artworks and software that challenges ideas about what makes something original or authored by a person. Blockchain technology has established decentralised asset ownership verification systems, which simplify digital asset tokenisation and provide transparent transaction protection against unauthorised modifications.[4] Because AI combines with blockchain technologies, the digital ownership frameworks have become difficult to handle, which creates the need for intellectual property rights (IPR) to be reevaluated regarding matters of digital identities and authorship and enforcement. Technology solutions that show promise for efficient security practices present regulatory and ownership disputes and deal with decentralised systems beyond current legal infrastructure capabilities.[5]

Digital Ownership in Cyberspace

Digital ownership in cyberspace encompasses traditional tangible rights along with virtual assets and AI-generated content because blockchain records are also included. Digital ownership requires cryptographic verification along with smart contracts and distributed ledgers to authenticate digital assets and determine their origin. Advances in decentralisation[6] Technologies now create such immense challenges for existing property law definitions that they need modern solutions for protection and recognition. Several fundamental queries regarding copyright laws and exclusivity,

[3] *Blockchain Technology for Enhanced IP Protection in India*, (Dec. 9, 2024), https://www.iiprd.com/the-role-of-blockchain-in-protecting-intellectual-property-rights-in-india/ (last visited Feb 14, 2025).

[4] Natalia Díaz-Rodríguez et al., *Connecting the Dots in Trustworthy Artificial Intelligence: From AI Principles, Ethics, and Key Requirements to Responsible AI Systems and Regulation*, 99 INFORMATION FUSION 101896 (2023).

[5] Nick Bostrom & Eliezer Yudkowsky, *The Ethics of Artificial Intelligence*.

[6] (PDF) Blockchain as a Type of Distributed Ledger Technology, https://www.researchgate.net/publication/348271633_Blockchain_as_a_Type_of_Distributed_Ledger_Technology (last visited Feb 14, 2025).

together with moral rights, have emerged because of non-fungible tokens (NFTs) and AI-generated content that exist as distinctive digital assets. Digital ownership relates to disputes regarding unauthorised reproduction and protection of intellectual property rights in combination with demanding digital rights enforcement between different legal jurisdictions. Without the basic set of laws governing the matter, there remains a grey area for stakeholders, from content creators to blockchain developers to policymakers, on how digital asset transfer and monetisation should happen.[7]

Realization and Importance of Digital Ownership

The explicit implementation of digital ownership becomes feasible through technology, especially AI and blockchain. Under traditional possession methods, ownership of physical assets provided clear evidence of ownership control. Digital ownership now means virtual element possession such as AI-generated content, digital art, cryptographic currencies and decentralised intellectual property (IP). These changes need governments to reconsider existing laws regulating intellectual property rights (IPR). Digital ownership provides advanced accessibility alongside innovation but creates missing links regarding the determination of digital content creators and digital asset copyright protection and revenue generation. Blockchain-based entities such as non-fungible tokens (NFTs)[8] and wise contracts enable new methods that help secure possessions and legal rights for cyberspace users.[9] These innovations simultaneously create problems related to piracy and unauthorised copying of content and uncertainty about which territories hold legal jurisdiction. The principle of digital ownership is examined in this paper through an exploration of IPR mechanisms which help protect AI intellectual property and blockchain-based assets.

Evolution of Intellectual Property Rights (IPR) in the Digital Age

The intent behind IPR has always been to safeguard creative and innovative works that the Discoverers, Artists and Businesses are rewarded for their creations.[10] Yet the transfer to virtual substance has added difficulties to traditional IP laws. Copyright laws, originally designed for literary, artistic, and musical works, are now being challenged by AI-generated content, in which human authorship is often lacking. Likewise, patents, which were traditionally human-invented,

[7] Non-fungible tokens (NFTs) and copyright law - Bird & Bird, https://www.twobirds.com/en/insights/2021/australia/non-fungible-tokens-nfts-and-copyright-law (last visited Feb 14, 2025).

[8] (PDF) The treachery of images: non-fungible tokens and copyright, RESEARCHGATE (2024), https://www.researchgate.net/publication/356810962_The_treachery_of_images_non-fungible_tokens_and_copyright (last visited Feb 14, 2025).

[9] Andres Guadamuz, *Back to the Future: Regulation of Virtual Worlds*, 4 SCRIPT-ED 242 (2007).

[10] The Fourth Industrial Revolution: Shaping A New Era | Columbia | Journal of International Affairs, https://jia.sipa.columbia.edu/news/fourth-industrial-revolution-shaping-new-era (last visited Feb 14, 2025).

have problems when AI creates something new without the guidance of a human. Trademarks are also adapting to digital branding as businesses create virtual identifiers for metaverse spaces and decentralised platforms. IP Laws and Regulations: The basics of IP laws and regulations have built-in limitations and loopholes depending on the jurisdiction. The growing dependence on AI and blockchain emphasises the need for a holistic approach to the governance of digital IP, crossing legal reforms & technology-driven enforcement.[11]

Role of Intellectual Property in Emerging Technologies

Intellectual Property has played an essential part in encouraging innovators by granting them exclusive rights to their inventions, literary works, and artistic creations.[12] The growth of AI-generated content and blockchain-based digital assets generates challenges that existing intellectual property rights (IPR) frameworks cannot remedy. On one side of the spectrum, traditional copyright law requires human authorship as a prerequisite before protection can be attached, often considering AI-generated works excluded from ownership claims, thus creating legal loopholes about their commercial use and licensing.[13] On the other side are blockchain-based assets, notably NFTs, whose decentralised operation does not always match with traditional methods of copyright enforcement where enforcement of ownership and dealing with infringement claims becomes difficult. While alternative patent protection exists for AI innovations, there is still an ongoing debate regarding the applicability to inventions generated by autonomous AI systems. Trademark conflicts, too, have arisen in virtual worlds as brands find themselves engaged in digital environments of identity theft, counterfeiting, and domain squatting. Thus, an urgent need has arisen to redefine intellectual property rights in light of modern-day scenarios for an ever-developing digital economy, as such changes would provide much-needed clarity on ownership, enforcement, and liability in AI- and blockchain-based ecosystems. Balancing the need for innovation with legal protection would allow policymakers to ensure that intellectual property law retains its relevance in protecting digital assets while also permitting technological advancement.[14]

AI and Blockchain in Redefining Digital Ownership

[11] Daryl Lim, *AI & IP: Innovation & Creativity in an Age of Accelerated Change*, (2019), https://papers.ssrn.com/abstract=3369200 (last visited Feb 14, 2025).

[12] Anusha Unnikrishnan, *ANALYZING THE IMPACT OF EMERGING TECHNOLOGIES ON INTELLECTUAL PROPERTY RIGHTS (IPR): A COMPREHENSIVE STUDY ON THE CHALLENGES AND OPPORTUNITIES IN THE DIGITAL AGE*, 10 LAW AND WORLD 66 (2024).

[13] Harshal Chhabra and Arihant Sethia, *The Impact of Artificial Intelligence on Intellectual Property Rights: A Case for Reform in Indian Patent Law by "Innovative Oversight" Approach*, IJLT (2024), https://www.ijlt.in/post/the-impact-of-artificial-intelligence-on-intellectual-property-rights-a-case-for-reform-in-indian-p (last visited Feb 14, 2025).

[14] Satyam Singh, *AI, NFTS AND IPR: LEGAL CHALLENGES IN INDIA* (2023).

Artificial Intelligence and Blockchain are forces of transformation in the digital ownership paradigms. Without assistance, AI systems can generate text, write music, create paintings, and produce software code. This brings many questions about ownership, authorship, and legal recognition. Will AI-generated works receive copyright protection?[15] And, if so, who owns it: the AI developer, the end user, or the entity that trained the model? Blockchain, too, has contributed greatly to the protection of digital assets as it provides decentralised and immutable ownership records. Agreements executed through smart contracts on the blockchain are transparent and self-executing, minimising the role of intermediary enforcement for IP purposes. NFTs are a mechanism by which AI-generated art, media, and collectables can be truly and verifiably owned, although they throw up questions of authenticity, replication, and legal recognizability. On the one hand, AI and blockchain alter the regulations of ownership; on the other hand, the interface of technology and law shall evolve to form the bedrock that secures and promotes fairness and accessibility upon these new conundrums related to digital assets.[16]

Statement of Problem

Artificial intelligence and blockchain technology have changed how people generate digital content and own assets and the prospects for protecting intellectual property. Artworks, literary works, and even software created by AI are creating challenges with intellectual property rights frameworks designed to mostly protect human authorship or invention. At the same time, these introduce methods of establishing ownership and rights management novel to blockchain-enabled assets such as non-fungible tokens (NFTs), smart contracts, and decentralised digital assets, which are yet to be widely accepted in law.

The most prominent problem centres on which the legal framework covers ownership over an AI-generated product. Most copyright and patent laws demand a human author or inventor, which begs whether that means that the output of an AI cannot be given authorship or inventorship status. This has resulted in different judicial interpretations regarding individual country regulations and, in some cases, regulatory uncertainty caused by a lack of international legal consensus on the issue.

Moreover, blockchain technology presents opportunities and challenges concerning digital asset protection. On the disruptive end, while it provides individuals with decentralised and immutable records for matters such as IP registration, licensing, and rights management, it raises issues like jurisdictional overlaps, violations with the enforceability of smart contracts, and misuse possibilities

[15] What is the purpose of copyright law? | Copyright Law | Mateo Aboy, PhD, MBA, https://www.mateoaboy.com/f6/blog_files/128ce98299902760f1c540b8dcf9eec5-4.html (last visited Feb 14, 2025).
[16] Non-fungible tokens (NFTs) and copyright law - Bird & Bird, *supra* note 7.

by internet hackers who might use it for infringing purposes. The absence of common global regulations makes legal recognition of IP protections via blockchain even more complex, hence the uncertainties on enforceability across different jurisdictions.

Moreover, various ethical issues, which include monopolisation of AI-generated content creation, misuse of deepfake technology, and copyright violations through blockchains, will require a balanced regulatory framework that protects the rights of these creators, innovators, and owners of digital assets while providing technological advancement.

Objectives of the study

The purpose of this research is to analyse the changing frontiers of Intellectual Property Rights (IPR) in the digital ecosystem, especially concerning AI-generated content and blockchain-based digital assets. The primary objectives of this research are:

- To study the applicability of copyright, patents, and trademarks for the protection of AI-generated works.
- To study how blockchain and smart contracts provide security for digital ownership.
- To identify the gaps in existing IPR laws concerning digital assets and AI-driven innovations.
- To analyse jurisdictional issues and enforcement mechanisms in cyberspace.
- To submit legal and policy recommendations aimed at strengthening IP protection in emerging digital environments.

Scope of the Study

This study will also examine the international legal frameworks, case studies surrounding AI generated content disputes, NFT ownership issues, and rights management under blockchains. Ethics-based considerations for the governance of digital IP will be further studied in the context of the challenge of balancing innovation, legal compliance, and market competitiveness.

Research Questions

1. How can IPRs so that AI-generated content is recognised, but not necessarily at the expense of fairness and innovation?
2. What legal and jurisdictional obstacles exist in enforcing intellectual property for digital assets on the blockchain?

3. How might policymakers implement a regulatory regime that is harmonised at least at a high level to balance innovation, ownership rights, and ethical issues in IP systems relying on AI and blockchain?

Research Methodology

The approach of this research is qualitative and analytic, combining doctrinal and empirical methods. The study is based on secondary data analysis of laws, judgments, international treaties, and academic papers relating to AI, blockchain, and digital IPR. A comparative legal analysis will evaluate the approach adopted by jurisdictions in the U.S., E.U., India, and China toward AI-generated content and blockchain-facilitated digital ownership.

Some case studies will look at landmark disputes regarding AI-generated works and NFTs, thereby shedding light on practical legal challenges that are developing. The research will also analyse reports from IP offices, regulatory agencies, and tech firms to map the ongoing conversation on policy and reform. Interdisciplinary perspectives from law, technology, and business will be integrated to evaluate the real-world impacts of digital IP protection.

Combining these legal, technical, and economic insights, this study will provide an example of digital ownership in cyberspace while recommending policies for the modernisation of intellectual property laws to assimilate AI and blockchain-led changes, thus sustaining fairness for creators, innovators, and owners of digital assets.

Research Design

The paper entitled "Interpreting Digital Ownership & Intellectual Property Protection for AI-Generated Content and Blockchain-Enabled Digital Assets in Cyberspace" employs a multi-dimensional research design combining doctrinal, comparative, and analytical approaches to investigate the legal, technological, and policy implications of digital ownership in the era of AI and blockchain.

AI-generated content and Intellectual Property Rights

Over the previous two years, the world has witnessed several ground-breaking advances in the field of Artificial Intelligence (AI). Its expansion has been unprecedented, with AI businesses developing fresh applications at a pace never before witnessed in this "out-of-control race". It has progressed

from simply being a tool in the hands of the artist to being one itself.[17] Countries throughout the world have been wrestling with its consequences, finding their laws insufficient when implemented in this changing setting.[18]

As artificial intelligence continues to redefine creativity and production, issues arise regarding how old standards, such as originality, should adapt to this new paradigm in intellectual property.

Understanding AI-Generated Content: Definitions and Types

Artificial Intelligence has been revolutionary for content creation, enabling machines to independently create artistic, literary, or inventive works. AI-generated content refers to the outputs produced by machine learning models, generative adversarial networks (GANs), and natural language processing (NLP)[19] systems with minimal to no human intervention. AI-generated outputs encompass a broad range, including music (e.g. Muse Net, built by OpenAI), visual art (e.g. DALL·E, Midjourney), written text (e.g. ChatGPT, Bard), or even the generation of inventions by computers in scientific and technological fields. The primary concern with AI-generated content lies in differentiating works carried out with human assistance from those autonomously generated by AI. For the applicability of intellectual property laws upon AI outputs, human expression is regarded in terms of inputting, prompting, and curating AI outputs. This emergent and growing phenomenon requires an evaluation of the old traditional IP frameworks that have classically been designed to protect human creativity and ingenuity.[20]

Challenges in Recognizing Artificial Intelligence as an Author or Inventor

Attribution of authorship and inventorship is one of the most undeniable and complicated legal issues arising out of AI-generated works. Existing intellectual property laws in copyright and patent-related statutes accept only human creators as rights holders. But as AI systems create original works on their own, the question arises: should AI be credited as an author or inventor? Current laws, such as the U.S. Copyright Act and the new EU Copyright Directive [21] essentially imply human authorship. AI-generated works are not accepted for copyright registration, as in the case of

[17] wipo_ip_ai_3_ge_20_inf_5.pdf, https://www.wipo.int/edocs/mdocs/mdocs/en/wipo_ip_ai_3_ge_20/wipo_ip_ai_3_ge_20_inf_5.pdf (last visited Feb 14, 2025).

[18](PDF) Impact Of Artificial Intelligence on Copyright Law: Challenges and Prospects, RESEARCHGATE, https://www.researchgate.net/publication/377334695_Impact_Of_Artificial_Intelligence_on_Copyright_Law_Challenges_and_Prospects (last visited Feb 14, 2025).

[19] Erik F. Tjong Kim Sang & Fien De Meulder, *Introduction to the CoNLL-2003 Shared Task: Language-Independent Named Entity Recognition*, (2003), http://arxiv.org/abs/cs/0306050 (last visited Feb 14, 2025).

[20] Sandeep Singh Sengar et al., *Generative Artificial Intelligence: A Systematic Review and Applications*, MULTIMED TOOLS APPL (2024), https://doi.org/10.1007/s11042-024-20016-1 (last visited Feb 14, 2025).

[21] Impact Assessment on the modernisation of EU copyright rules | Shaping Europe's digital future, (2016), https://digital-strategy.ec.europa.eu/en/library/impact-assessment-modernisation-eu-copyright-rules (last visited Jul 28, 2024).

"Thaler v. USPTO", in which the U.S. Patent and Trademark Office refused to treat an AI system (DABUS) as an inventor of a patent.[22] These challenges point toward the need for legislative alterations that could permit hybrid authorship models under which rights may be shared between human programmers or authors and AI systems or acknowledge AI as a separate legal entity with limited ownership rights. These dilemmas become all the more complicated due to ethical and economic implications, even as there may be changes in traditional market structures on revenue sharing for artists, writers, and inventors.

Copyright Protection for AI-Generated Works

It could be stated that "the author" is defined as any person who causes work to be created by a computer, as stipulated in "Section 2(d) of the Indian Copyright Act.[23]" Therefore, claims for authorship of works developed devoid of human intervention are somewhat diminished by the statement. Thus, neither the creator of the device, the machine itself, nor, to some extent, the copyright owners of the music in the machine's database are entitled to protection.[24] In that respect, only the individual who merely instructed the AI to compose the song would be entitled to such protection. While examining AI-generated documents,[25] it is also critical to see originality and inventiveness. A musical work in India is protected only if manifested in some form of external expression. "Copyright protection is available for works under Section 13[26] of the Act whose originality is demonstrated." However, AI is devoid of classic human attributes like creativity, intuition, and judgment[27]; it defines anything through mere algorithms and processing. Ethical quandaries and the possibility of infringement surface due to the distinct nature of AI innovation and the existing legal system. Assigning a separate personality to AI aggravates the predicaments arising from its lack of agency regarding contractual matters. Moral rights to be enjoyed by authors "under Section 57 of the Act will be difficult to enforce in the case of AI-generated works, as AI cannot recognise infringements that hurt its fame. Besides this, AI cannot distinguish between moral right and wrong; hence, making a case against it for creating undesirable information would be a tremendous challenge.[28]"

[22] Patentability of inventions created by AI—the DABUS claims from an Indian perspective | Journal of Intellectual Property Law & Practice | Oxford Academic, https://academic.oup.com/jiplp/article-abstract/15/11/879/5948823 (last visited Jan 21, 2024).
[23] Section 2 in The Copyright Act, 1957, https://indiankanoon.org/doc/797096/ (last visited Feb 14, 2025).
[24] Rupendra Kashyap vs Jiwan Publishing House on 1 July, 1996, https://indiankanoon.org/doc/134584/ (last visited Dec 21, 2023).
[25] P. Bernt Hugenholtz & João Pedro Quintais, *Copyright and Artificial Creation: Does EU Copyright Law Protect AI-Assisted Output?*, 52 IIC 1190 (2021).
[26] Section 13 in The Copyright Act, 1957, https://indiankanoon.org/doc/4010217/ (last visited Jun 12, 2024).
[27] Law Essentials, *RG ANAND v. DELUXE FILMS AND ORS.*, LAW ESSENTIALS, https://lawessential.com/ip-case-laws/f/rg-anand-v-deluxe-films-and-ors (last visited Dec 8, 2023).
[28] Section 57 in The Copyright Act, 1957, https://indiankanoon.org/doc/1710491/ (last visited Jun 14, 2024).

One legislative option is to classify all AI-generated works as public domain and thus ineligible for any form of protection under copyright law, depending on the costs and benefits of affording any sort of protection.[29]

Patentability of AI-Created Innovations

The contribution of AI in scientific research and technological innovations has increased tremendously. AI systems can be used for producing new drug compounds, engineering new materials, and optimising industrial processes. Patents are a means that serves as an incentive to inventors for innovating. However, as stated by the current patent laws, they require a human inventor to claim ownership, which is evident in the DABUS[30] patent cases in which multiple patent offices, including the USPTO, denied AI as an inventor. It raises the fundamental issue about the scope of patent law in the age of automation by refusing patents for AI-generated inventions. If AI cannot be recognised as an inventor, should the patent rights belong to the human operators, developers, or corporations owning AI systems, or do we need a new category of "AI-assisted patents," differentiating between human-guided and locked-up autonomous AI inventions? Raising these questions is necessary to create a legal environment for innovation that has space for increasing AI integration into technological advancement.[31]

Trademark and Branding Issues vis-á-vis AI Content Creation

Trademarks are protective shields over the identity of a brand such that they can enable consumers to distinguish one good and service from another in the market. AI branding is automated branding, which includes AI-generated logos, slogans, and virtual celebrities, challenging the traditional notions of trademark doctrine. For instance, AI-based design tools can now produce logos without any direct intervention from humans, hence the question of who owns the trademark and its distinctiveness. AI-generated branding objects have a potentially increased risk for trademark infringement and dilution since human edits from the training of existing brand identities would inadvertently create similar outputs. It is also linked to the development of deepfake technology and AI-generated virtual personalities (e.g., Lil Miquela), which place a thin line between real and synthetic brand ambassadors. Current trademark legislation will require the adaptation of AI-generated brand assets to set out the parameters for the registration and enforcement of AI-based trademarks. This increases the legal risk for companies using AI for branding and marketing rather,

[29] AI and copyright: exploring exceptions for text and data mining, https://cms-lawnow.com/en/ealerts/2024/10/ai-and-copyright-exploring-exceptions-for-text-and-data-mining (last visited Feb 14, 2025).
[30] Artificial Intelligence system as inventor in South African patent application: The case of DABUS - The IPKat, https://ipkitten.blogspot.com/2021/08/artificial-intelligence-system-as.html (last visited Nov 1, 2023).
[31] Ananya Ray, *AI IN IPR : LEVERAGING TECHNOLOGY FOR EFFICIENCY AND ADDRESSING CONCERNS* (2023).

as it leaves companies with loopholes when using AI content commercially to cover their backs while reducing the damage caused by possible infringement issues.[32]

Blockchain and the Evolution of Digital Asset Ownership

NFTs Steal the Fashion Show and Decline Digital Ownership

The arrival of non-fungible tokens (NFTs) has altered the very definition of digital ownership by allowing for the creation, transfer, and authentication of unique digital assets via means of a blockchain network. Unlike traditional digital files, which can be duplicated and diffused infinitely, the very smart security of NFTs bestows on them provably owned and scarce rights. This, in turn, enabled artists, musicians, and the creative world to earn revenues under this scheme while controlling their intellectual property. However, copyright circuitry, which can involve the actual enforcement of rights, declares the NFT[33] marketplaces to generally be decentralised. Ownership of an NFT does not, however, necessarily confer to the owner of the NFT the underlying intellectual property rights. There are pending uncertainties regarding whether the same NFT[34] can be sold, how royalties can be enforced, and whether fraudulent listings have been made with copyrighted materials. It is thus apparent that, with the ever-expanding markets for NFTs in gaming, fashion, and real estate, the legal environment governing the purchase and sale of digital assets needs to be considered with urgency to guard against the unauthorised exploitation of creative works.

Smart Contracts and Enforcement of IP Rights

Smart contracts represent a particular kind of self-enforcing agreement designed to be coded to specific blockchain networks. Smart contracts, by automating the transactions and performance of contracts dependent on governed situations, naturally play a significant role in the execution of intellectual property rights. They allow rightsholders to receive automatic royalty payments without intermediaries, thereby stopping unauthorised reproduction of their works and maintaining their digital records. Examples from the music industry describe smart contracts as facilitating revenue-sharing arrangements among artists, producers, and distributors in a transparent manner based on pre-agreed ownership shares. In an analogy here, digital artistic works and literary works can be similarly protected through licensing agreements coded to the blockchain that is automatically executed on resale or reproduction. Despite the advantages of efficiency, a clever contract has legal

[32] Protecting Trademarks in the Era of Artificial Intelligence, (Jan. 27, 2025), https://depenning.com/blog/protection-of-trademarks-in-the-age-of-artificial-intelligence/ (last visited Feb 14, 2025).

[33] (PDF) A comprehensive study on Non-Fungible Tokens (NFTs): Use cases, ecosystem, benefits & challenges, https://www.researchgate.net/publication/361443799_A_comprehensive_study_on_Non-Fungible_Tokens_NFTs_Use_cases_ecosystem_benefits_challenges (last visited Feb 14, 2025).

[34] Shashank Pathak, *Information and Technology (Intermediaries Guidelines) Rules 2011: Thin Gain with Bouquet of Problems* (2013).

complications, such as difficulty modifying agreements after deployment and a lack of recognised mechanisms for dispute resolution. In fact, in many jurisdictions, their enforceability remains unvalidated in traditional legal systems that have yet to define a smart contract as a lawfully binding instrument. Hence, the need to respond to these challenges represents a merging of legal principles with the fast-altering technological environment to ensure a well-placed adaptation of smart contracts with shifting landscapes of law that protect intellectual property.

Legal Recognition of Blockchain-Based Ownership Records

A decentralised and immutable mechanism for recording and verifying ownership makes blockchain-based protection highly relevant to intellectual property. The blockchain's immutable record of transactions authenticates the origin, transfer, and licensing of digital assets and thus provides some level of assurance against counterfeiting and unauthorised use. This innovation would fundamentally change copyright and patent registration by creating transparent and verifiable records of ownership accessible all over the globe. Some jurisdictions have already started investigating integrating blockchain within their intellectual property registration systems, appreciating how it can improve both the speed of administrative processes and the security of rights management. Legal recognition of blockchain-based ownership records diverges from country to country, with some legal provisions asking how credible blockchain records can be as evidence during legal disputes. The decentralised character of the blockchain creates yet additional obstacles regarding jurisdictional competence, especially in matters of intellectual property infringement that straddles a multitude of territories. Building a definitive common legislative framework acknowledging blockchain-based ownership records as valid evidence of property rights is a major reason to restore faith and promote compliance in digital asset markets.[35]

Regulatory Issues Challenging Blockchain-Enabled IP Transactions

Despite its power to upend this realm of digital asset ownership, blockchain has compounded the enforcement function of intellectual property by raising numerous regulatory challenges. One chief concern here is the anonymity and decentralisation of blockchain transactions that have been able to pave the way for bad actors to exploit copyrighted material in an unaccountable fashion. Besides, due to pseudonymity, it is said that it would be more difficult to trace and act legally towards infringers, giving rise to concerns over piracy, counterfeiting, and violations of digital rights. Another set of concerns is that blockchain, due to its global nature, raises questions regarding jurisdictional enforcement; legal systems with no common regulatory framework find it difficult to

[35] A systematic review on blockchain-based access control systems in cloud environment | Journal of Cloud Computing | Full Text, https://journalofcloudcomputing.springeropen.com/articles/10.1186/s13677-024-00697-7 (last visited Feb 14, 2025).

pin down the boundaries of the buying, selling and transferring of digital assets. A large majority of IP disputes deal with cross-border cooperation in blockchain-embedded transactions, yet we have accepted international treaties and agreements that fail to address specific cases under decentralised technology. In addition, environmental issues have also arisen about blockchain networks that use proof of work consensus mechanisms since their energy-intensive nature has been proposed as a constraint on large-scale exploitation. Regulating bodies will have to come up with a solution now that addresses consumer protection, rights enforcement, and legal certainty in the realisation of its pros on IP transactions based on blockchain. Such adaptable policies would eventually bring international cooperation for alignment of their legal frameworks with the advance of technology so that innovations are encouraged with equity of IP protection in the digital age.

Digital Rights Management (DRM) via blockchain

DRM helps to prevent misuse in the digital space, essentially protecting intellectual property by preventing illegal access, copying, or distribution of copyrighted materials. DRM is mostly supported through a centralised authority such as copyright owners, licensing bodies, and even digital platforms on which restrictions are applicable for the use of content. The centralised model has drawbacks, majorly including single points of failure, vulnerability to hacking, lack of transparency, and high operational costs. Thus, using blockchain emerges as the best transforming, redefining the possible extension of DRM[36] by decentralising it, making it immutable, disclosing its underlying transparency, and automating the process through smart contracts.

Through blockchain-based DRM, content creators and rights holders can register their works on an unalterable ledger that guarantees verifiable ownership and automatic royalty distribution. NFTs mean that new dimensions of owning a digital asset have been opened since metadata can be input to ensure proof of authenticity/provenance. Creating smart contracts benefits DRM by automatically giving effects to licensing agreements and royalty payments while reducing the number of intermediaries to effectuate fair compensation for artists, musicians, and authors. Audius, Mycelia, and similar platforms monopolise blockchain to benefit artists with their music over distributed channels and earnings.[37]

However, with all such advantages, DRM based on blockchain also has issues. The main difficulties faced by decentralised DRM are scalability issues, high energy usage in proof-of-work (PoW) blockchains, and the complexity of associating them with the classical copyright framework.

[36] Digital Rights Management (DRM), https://studylib.net/doc/5217347/digital-rights-management--drm- (last visited Dec 26, 2023).
[37] Narendra Singh Shekhawat, *DIGITAL TRANSFER DOCTRINE THROUGH NFT: A*, 2.

Furthermore, jurisdictional disputes and problems of enforcement arise because blockchain transactions are pseudonymous and global. However, as this technology grows, the possibility of changing the future of DRM[38] frameworks, making digital rights management more secure, transparent, and efficient, is bound to happen.

Challenges and Limitations of Blockchain-Based IPR Systems

Of course, the advantage of blockchain is the novel way it helps protect intellectual property rights (IPRs) without limitation regarding licensing and enforcement. However, it presents various challenges and limitations concerning strict engagement in its adoption.

First on the agenda is legal validity and regulatory ambiguity. Several jurisdictions haven't put up a well-defined legal framework for registering and enforcing IP rights using blockchain. Intellectual property law attaches to territoriality, which, in turn, makes effective enforcement difficult due to the decentralisation and borderless phenomena of blockchain. For example, if a dispute comes up regarding blockchain copyright registration, there is no clear information on whose countries' laws apply. Thus, adjudicating such cases may be complicated.[39]

Another major challenge is brought forth by immutability along with fault correction. The records kept in the blockchain are tamper-proof because of this feature. Still, at the same time, it also hampers error rectification. For immutable records, in the case of recorded wrong ownership or fraudulent claims, reverse correction can be a tedious task and sometimes even impossible without the intervention of a centralised organisation in contradiction to the principle of decentralisation in blockchains.

Scalability and cost efficiency also add to the list. Public blockchains require a lot of computational resources, especially with PoW consensus, leading to increased transaction costs and consuming massive amounts of energy. Newer consensus models like PoS, along with layer-2 solutions, are coming up to solve scalability issues but have yet to see mass adoption.

Privacy and unlicensed copying issues also arise within IP systems in a blockchain. Although blockchain records the transaction transparently, the users can choose to remain pseudonymous; this makes it nearly impossible to trace infringers in cases of copyright violation. Unregulated, decentralised platforms can easily allow unauthorised sharing of copyrighted content, which disintegrates the very idea behind copyright protection.

[38] hometip-DRM Library Education Tip Sheet.pdf, https://www.ala.org/sites/default/files/advocacy/content/advleg/pp/hometip-DRM%20Library%20Education%20Tip%20Sheet.pdf (last visited Feb 14, 2025).

[39] Atharv Chandratre & Abhinav Pathak, *Blockchain Based Intellectual Property Management*, SSRN JOURNAL (2019), https://www.ssrn.com/abstract=3800734 (last visited Feb 14, 2025).

Finally, there is the technical and legal block to the integration of blockchain with current patterns of IP enforcement. Unlike currently existing copyright offices, patent registries, and courts, which operate on traditional centralised databases, cross-compatibility with decentralised blockchain systems complexifies the entire issue. Hybrid models need to be devised by policymakers and IP stakeholders to carry the advantages of transparency and security that blockchain offers onto the reliability of institutional structures of the conventional IP framework.[40]

Even though these challenges still exist, on the other hand, blockchain also opens doors to an innovation pattern in IPR management. As governments and legal institutions refine regulations and regulations while the evolution of technology continues, the use of blockchain in IP protection can be seen as the cornerstone of digital ownership and enforcement of intellectual property in the future.

Legal and Regulatory Frameworks Governing AI and Blockchain in Cyberspace

The development of artificial intelligence (AI) and blockchain technologies has revolutionised how we manage digital ownership and protect intellectual property rights (IPR). Present legal structures encounter difficulties when implementing these new technologies because they create empty regulatory areas and between-country conflicts with weak enforcement capabilities. This section comments on the compatibility of present intellectual property rights legislation and international treaties, together with legal jurisdiction issues and legislative modifications for AI and blockchain property protection within digital domains.[41]

Existing IPR Laws and Their Applicability to AI and Blockchain

The current structure of intellectual property regulations faces difficulties when trying to protect human-developed creative work since these laws were created to safeguard the intellectual output of humans. The present IPR system, founded on copyright and patents and trademarks, together with trade secrets, grants rights to creators while recognising their authorship. The lack of legal personhood status for AI interferes with intellectual property laws since AI operations violate existing definitions regarding authorship and invention.

Most territories, which include the United States (Copyright Act, 1976) and the European Union (Directive on Copyright in the Digital Single Market, 2019), maintain human authorship as a fundamental requirement for copyright safeguard. AI-generated content lacks copyright protection because any unaltered AI product counts as machine-generated material beyond current copyright

[40] Decentralized IP: Can Blockchain Resolve the Copyright Crisis? - LeDroit India, (Dec. 29, 2024), https://ledroitindia.in/decentralized-ip-can-blockchain-resolve-the-copyright-crisis/ (last visited Feb 14, 2025).
[41] Avinahs Kumar, "Economics and IPR System in India" 4 International Journal of Law Management & Humanities 273 (2021).

framework boundaries. Artificial intelligence-generated content ownership remains unclear because it falls between defined rights of ownership and licensing of human-created works.[42]

The issue of inventorship remains unresolved in patent law when it comes to AI-generated inventions. *"Cases like Thaler v. USPTO (2021) and Thaler v. The EPO (2022), together with AI (2021), rejected AI as an inventor and thus required human involvement during patent applications."*

Blockchain technology provides decentralised DRM systems and copyright registration options through its network, but the world lacks official legal recognition for blockchain IP protection solutions. Different jurisdictions maintain an uncertain position toward blockchain-based IP registrations since they lack recognition as binding ownership evidence.

However, existing IPR laws are inadequate for embracing the special requirements of AI and blockchain-produced assets. Legal adjustments must be implemented to establish a clear understanding and effective execution along with asset protection within contemporary digital systems.

International Treaties and Guidelines on Digital IP Protection

The worldwide protection of intellectual property counts on international organisations together with treaties that work to standardise borderless IP protection. The fast development of AI alongside blockchain technology has demonstrated that current worldwide IP systems struggle to fulfil their purpose because they were originally built to protect conventional creative art and industrial products.

International digital IP regulation folds into three main treaties alongside others:

- The Berne Convention from 1886 remains one of the oldest copyright treaties that provides literary and artistic work protection yet does not extend its provisions to AI-generated works.
- Through its membership with WTO, the TRIPS Agreement (1994) establishes essential protection standards for patents and trademarks, but it fails to handle AI authorship registrations with blockchain technologies.
- The WIPO Internet Treaties (1996) contain two components, including the WIPO Copyright Treaty (WCT)[43] and WIPO Performances and Phonograms Treaty (WPPT)[44], but their provisions do not extend to smart contracts, blockchain-based systems or non-fungible tokens.

[42] MATT BLASZCZYK, GEOFFREY MCGOVERN & KARLYN D. STANLEY, *Artificial Intelligence Impacts on Copyright Law*, (2024), https://www.rand.org/pubs/perspectives/PEA3243-1.html (last visited Feb 14, 2025).

- The EU Digital Services Act (2022) and the AI Act (2023) establish European regulations about AI-based content generation and online platforms, which might guide worldwide legal advancement.

International laws about AI, specifically those protecting blockchain IP, remain missing, which leads to difficulties in legal enforcement throughout different jurisdictions. The international institutions WIPO and WTO need to revise their regulatory frameworks to include policies about AI-generated works together with decentralised asset ownership protocols and smart contract-based licensing systems.

Comparative Analysis of Global IPR Regulations on AI and Blockchain

Artificial intelligence and blockchain technologies are advancing faster than traditional intellectual property rights legal frameworks because they produce legal uncertainties that differ from jurisdiction to jurisdiction. Each country has established its specific regulations for AI-manufactured material and blockchain-based assets because their legal systems and policy targets differ from one another. AI-generated works in the United States do not receive copyright protection unless human creators make meaningful contributions based on the stance of the U.S. Copyright Office. The European Union stands apart from the United States when it comes to copyright regulation since it plans to merge AI systems with its current laws and strengthen individual protections for AI-produced works. Blockchain regulations face significant differences between countries because Switzerland recognises cryptocurrency and smart contracts under friendly regulations even though China has implemented bans on crypto activities and controls state-controlled blockchain development. Singapore, alongside Japan, operates regulatory test grounds which allow blockchain applications to undergo inspection ahead of establishing formal legal restrictions. A harmonised global framework for intellectual property rights protection of AI and blockchain must be established because existing approaches demonstrate the necessity of strikes between innovation and legal security.

Jurisdictional Challenges in Enforcing IPR in Cyberspace

The highest challenge to IPR enforcement across cyberspace stems from complicated jurisdictional issues. AI and blockchain assets operate from a borderless digital domain where enforcement of national laws during international disputes becomes highly challenging.

[43] WIPO Copyright Treaty (WCT), https://www.wipo.int/treaties/en/ip/wct/ (last visited Nov 28, 2023).
[44] WIPO Performances and Phonograms Treaty, https://www.wipo.int/treaties/en/ip/wppt/ (last visited Dec 26, 2023).

Blockchain networks function without centralised control thus, copyright theft alongside trademark and patent disputes remains untraceable across various jurisdictions because there exist no authorised legal tracking systems.

AI-generated content begins its life in one country before moving into international storage for global usage, which produces legal ownership and copyright length disputes.

Many intellectual property agreements involving blockchain use self-executing digital agreements known as smart contracts for their execution. Several countries have not accepted smart contracts as enforceable agreements, which produces disputes about intellectual property licenses along with royalty payments and digital asset transfers.[45]

Case Example: In the case of *"Dapper Labs vs. The SEC, it studied NFTs to determine their status as securities during the regulatory debate about digital property rights in 2023.*"

The growing challenges demand international strategic partnerships, which should aim to generate standard regulations for IP protection across virtual domains.

The Need for New Legal Frameworks and Policy Interventions

The original IPR regulations came from before computers and digital technology, so they do not work well when AI and blockchain applications appear. When it comes to AI-generated creations, there is no set legal structure which makes litigation happen over intellectual property rights.[46] The unique nature of blockchain NFTs makes them different from traditional property laws since NFT owners do not acquire copyright protection over their content. The current digital asset regulations do not fit the market, so new laws need to be formed to protect users and enable progress in this sector. Policy creators must create AI-unique copyright laws to establish minimum human control limits for protection and special rights for AI-developed content. The market should adopt uniform blockchain protocols to make IPR rights tracking accessible through safe platforms. Regulatory bodies must develop DAO standards to establish this new governance system legally.[47] The use of blockchain-supported digital contracts following regular legal standards can connect blockchain technology with standard legal frameworks. A mixed policy solution that accepts new technology while allowing speed changes will keep IP regulations effective in digital network-based markets.

[45] Narender Kumar, *CRYPTOCURRENCY, INTELLECTUAL PROPERTY RIGHTS AND COMPETITION LAW-CHALLENGES AND IMPLICATIONS*, 1.

[46] Adil S. Al-Busaidi et al., *Redefining Boundaries in Innovation and Knowledge Domains: Investigating the Impact of Generative Artificial Intelligence on Copyright and Intellectual Property Rights*, 9 JOURNAL OF INNOVATION & KNOWLEDGE 100630 (2024).

[47] Singh - 2023 - AI, NFTS AND IPR LEGAL CHALLENGES IN INDIA.pdf, https://www.slsnagpur.edu.in/assets/pdf/journal/12.%20AI,%20NFTS%20AND%20IPR%20LEGAL%20CHALLENGES%20IN%20INDIA_Satyam%20Singh.pdf (last visited Feb 14, 2025).

Emerging Policies and Legislative Reforms for Digital Ownership

Legislative reforms by countries aim to fill the existing legal gaps within AI and blockchain-based IP protection systems.

AI-Generated Content Laws:

- The UK Intellectual Property Office (IPO) considers suggesting restricted copyright rights for AI-created work outputs.
- The National AI Development Plan of China states that AI-created content should receive copyright protection through existing legal frameworks.

Blockchain IP Reforms:

- The EU Blockchain Strategy endorses blockchain systems for copyright registration along with IP verification functionalities.
- The United States Copyright Office currently studies how to establish NFTs together with blockchain technology as proof to validate digital ownership rights.

Proposed Digital Ownership Legislation:

- The European Commission's AI Act (2023) stands as among the initial extensive sets of laws which govern AI-generated content along with automated decisions.
- The Draft Digital Personal Data Protection Bill (2023), which India introduced, incorporates sections about data ownership alongside AI-generated content regulatory measures.
- The progress of technological innovations shows a deepening understanding of digital ownership in modern legislation because international synchronisation continues to be a major hurdle.

Ethical and Policy Considerations in AI and Blockchain-Enabled IP

The current emergence of AI technology, together with blockchain systems, produces problems needing thorough ethical examination while requiring new policy development.

Ethical Ownership of AI-Generated Content:

- Policy decisions must determine whether AI-developed works should receive recognition from AI systems or developers or the end-users who trigger AI functions.

- The improper management of generative AI, together with deepfake manipulation, raises major privacy-related issues and produces false information.

Monopoly and Fair Use in AI-Generated IP:

- Technological firms possessing enormous dataset resources and AI model capabilities seem likely to control AI-generated content markets, thereby gaining control over digital creativeness.
- The existing fair use doctrine in copyright law requires evaluation because it needs to address both new AI capabilities and human creative rights.

Blockchain's Impact on IP Accessibility:

- The democratisation of IP registration on blockchain faces resistance from the high costs of transactions and environmental effects and regulatory limitations that hamper its adoption.

Balancing Innovation and Regulation:

- The evolution of IP policy demands a proper equilibrium between AI and blockchain advancements and fraud prevention measures, which stops all forms of misuse and monopolistic behaviour in the future.

Conclusion and the Future of IPR in Cyberspace

Findings & Recommendations

The intersection of artificial intelligence (AI), blockchain, and intellectual property rights (IPR) in cyberspace presents both unprecedented opportunities and complex legal challenges. AI-generated content raises fundamental questions about authorship, originality, and ownership, while blockchain-based digital assets challenge traditional property and copyright laws. Key findings indicate that existing IPR frameworks are inadequate to address these emerging issues, necessitating legal reforms that account for technological advancements. AI-generated works lack clear ownership rights in many jurisdictions, creating legal uncertainties for artists, developers, and businesses. Similarly, while blockchain offers transparent and immutable ownership records, its decentralised nature complicates enforcement and regulatory oversight. The study also highlights enforcement difficulties in cyberspace, as digital assets transcend national borders, making jurisdictional enforcement highly complex.

To address these challenges, the following recommendations are proposed:

1. introducing sui generis protections for AI-generated works to provide clarity on ownership and licensing rights,

2. developing standardised legal frameworks for blockchain-based digital assets to ensure secure and legally recognised ownership,
3. fostering international cooperation to create cross-border enforcement mechanisms, and
4. leveraging emerging technologies such as AI-powered copyright detection tools and blockchain-based digital rights management (DRM) systems to improve IPR enforcement. Policymakers, legal scholars, and technology experts must collaborate to ensure that IPR laws remain adaptable to the fast-evolving digital landscape while upholding the rights of creators and innovators.

The Role of Legal Reforms in Digital Ownership Protection

Digital ownership development relies heavily on legal reforms which protect intellectual properties through enforceable laws during the digital era. Laws regarding copyright alongside trademark and patent must undergo review to establish appropriate codes for AI-generated production together with blockchain transactions. The establishment of detailed guidelines concerning human participation levels needed for copyright protection of AI-generated work will create essential legal stability. Featuring smart contracts in legal systems should take place to enable automatic agreements to finalise digital asset transactions between parties. Regulatory entities need to create operational frameworks which merge both technological advancements and consumer protection protections. Market transparency and prevention of legal disputes rest on the establishment of transparent regulations about NFT ownership together with licensing and resale rights. The authorisation of blockchain-based IPR registries at domestic and foreign levels will enhance intellectual property defence systems through unalterable evidence of ownership documentation. The adoption of unified legal practices related to these matters guarantees that AI and blockchain technology add positive value to creative economics while preventing security vulnerabilities that permit copyright infringement.

Future Trends in AI, Blockchain, and Intellectual Property

AI and blockchain technology will develop further to strongly affect our current performance rights system. The growth of AI technology requires new copyright regulations that allow AI creativity while safeguarding creators' rights in all industries, including word and music production and program and graphic source code. The future of rights security depends on AI technology that helps find digital IP violations through forecasting and performs automated copyright searches.

People worldwide will find it harder to distinguish physical from digital ownership because of DeFi development and tokenisation of assets and metaverse systems. Web3 technologies encourage ownership shared among users, so current IP governance regulations demand fresh ways to handle

intellectual property made by multiple parties. As blockchain switches to lower-energy consensus mechanisms like proof-of-stake, the authorities will concentrate their inspections on examining blockchain transactions according to legal and ethical standards. Digital identity solutions that save verified credentials on the blockchain will protect intellectual property assets and help prevent fraud in managing digital asset ownership.

Final Thoughts on the Balance Between Innovation and Regulation

The full potential of online intellectual property protection depends on finding proper control between developing creativity and having strict oversight regulations. The development of AI and blockchain technology needs proper oversight since their rapid growth may increase copyright infringements and create market control while violating ethical property rights. Policy leaders must lead changes in digital IP regulations instead of just responding to new technology lacunas. People from different groups, such as lawyers, engineers, content makers and IP regulations makers, should work together to build ideas that guard copyright rights and benefit creative freedom. Using AI and blockchain technology with global IP rights-sharing strategies will make up a system that gives everyone a fair and balanced chance in our digital economy. The success of IPR in cyberspace will come from ensuring creators get fair protection and allowing modern technology to transform digital property standards.

****