Reflections on the Development Path of Copyright Protection for Digital Products from the Perspective of Blockchain Technology Development

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Abstract: With the rapid advancement of information technology, the application of digital products across various domains has become increasingly pervasive. Nonetheless, the issue of copyright protection for digital products remains a formidable challenge. Traditional methods of copyright protection, such as Digital Rights Management (DRM) and copyright registration mechanisms, have alleviated copyright infringement to some extent; however, these approaches prove inadequate in the face of the increasingly intricate digital landscape. Blockchain technology, with its decentralized, immutable, and transparent attributes, offers a novel solution for the copyright protection of digital products. Through blockchain technology, secure registration, tracking, and management of digital product copyrights can be achieved, while smart contracts can automate the processes of copyright licensing and payment. This paper examines the current state and challenges of blockchain technology in the realm of digital product copyright protection, and proposes a series of developmental pathways and legal policy recommendations grounded in blockchain technology, aiming to provide fresh perspectives and methodologies for the safeguarding of digital product copyrights.

1. Introduction

In the era of the digital economy, the rapid development and proliferation of digital products have increasingly highlighted issues surrounding copyright protection. Traditional methods of copyright protection primarily rely on Digital Rights Management (DRM) and copyright registration and tracking systems. These approaches employ technological measures to restrict the copying and distribution of digital products and establish registration systems to ensure the legitimacy of copyright ownership. However, with advancements in technology and the complexity of the online environment, problems of piracy remain severe, disputes over copyright ownership are frequent, and tracking infringement has become increasingly challenging. In this context, there is an urgent need for novel technologies to effectively address these challenges. The advent of blockchain technology brings new hope for copyright protection of digital products. By leveraging blockchain technology, decentralized copyright registration and tracking can be achieved, ensuring the

immutability and transparency of copyright information. The application of smart contracts can automate the handling of copyright licensing and payments, reducing human intervention and errors. These advantages render blockchain technology a promising solution for the protection of digital product copyrights.

2. Current Major Methods and Technologies for Copyright Protection

2.1. Digital Rights Management (DRM)

Digital Rights Management (DRM), as one of the principal methodologies for copyright protection today, employs technological means to restrict the duplication and dissemination of digital content, thus safeguarding the interests of copyright holders. DRM systems typically encompass functionalities such as encryption techniques, access control, and usage permissions, all designed to thwart unauthorized copying, sharing, and usage. Nevertheless, the application of DRM technology encounters numerous challenges. Firstly, overly stringent DRM measures may diminish the user experience, engendering feelings of irritation and resistance among legitimate users. Secondly, while DRM can technically curtail certain forms of piracy, its own security is still susceptible to hacking and technological circumvention. Additionally, the implementation and maintenance costs of DRM can be substantial, posing an economic burden for small to medium-sized enterprises and independent creators. Nonetheless, the role of DRM in copyright protection should not be underestimated. It provides copyright holders with an effective technological means to, to some extent, curb the illicit spread of digital products. In the future, DRM technology must seek a balance between safeguarding copyright and enhancing user experience. The integration with blockchain technology may offer a more transparent and secure method of improving the credibility and acceptability of DRM systems, thereby achieving more effective digital copyright protection [1].

2.2. Copyright Registration and Tracking Mechanisms

The mechanism of copyright registration and tracking serves as a crucial tool for safeguarding intellectual property, achieved through the registration and recording of copyrighted works via official or third-party platforms. This ensures the legitimacy and traceability of copyright ownership. The essence of this mechanism lies in establishing an authoritative and transparent database, where each copyrighted work is accompanied by a clear registration record, thus providing robust evidence in the event of a copyright dispute. Copyright registration is not only the legal foundation for copyright protection but also a vital measure to prevent infringement. Nonetheless, traditional copyright registration and tracking mechanisms exhibit certain shortcomings. The registration process is often cumbersome and time-consuming, which can impose significant temporal and financial burdens on independent creators and small to medium-sized enterprises. Furthermore, tracking mechanisms frequently struggle to effectively monitor and manage the use of copyrighted works within the complex digital landscape, leading to persistent instances of infringement. In the context of blockchain technology's advancement, copyright registration and tracking mechanisms can be substantially enhanced. The decentralized and immutable nature of blockchain renders the registration process more efficient and secure. Each registration of a copyrighted work can be recorded on the blockchain, creating a permanent and unalterable record of copyright. Tracking mechanisms leverage the transparency of blockchain to achieve real-time monitoring of the use of copyrighted works, greatly improving the efficacy of copyright protection. This integration not only addresses many of the issues inherent in traditional mechanisms but also paves the way for innovative developments in copyright protection.

3. Major Challenges Ahead

3.1. Piracy Problems

In the realm of blockchain technology, one of the principal challenges facing digital product copyright protection is the issue of piracy. This problem not only constitutes a direct economic harm to digital products but also reveals the inherent fragility of today's digital copyright management systems. Firstly, the issue of piracy is deeply rooted in the ease with which digital products can be replicated and disseminated. Once a digital product is cracked or illicitly copied, it can spread rapidly across the internet with virtually no limitations imposed by physical media. This speed and reach of distribution far exceed the impact of traditional piracy, severely constricting the market space for legitimate products and causing substantial economic losses for content creators and copyright holders. Moreover, the existing legal and regulatory frameworks are markedly lagging in addressing digital piracy. Despite ongoing efforts to enhance copyright protection laws globally, the complexity of the online environment and the transnational nature of the issue create significant enforcement challenges. Pirates often exploit the anonymity of the internet and employ techniques such as virtual private networks (VPNs) to evade detection, further complicating copyright enforcement. Additionally, the lack of awareness among users regarding copyright issues is a significant contributing factor to the proliferation of piracy. Many consumers, driven by economic considerations or convenience, opt to download pirated products, disregarding the respect due to the creators' labor. This widespread consumer behavior perpetuates a fertile ground for the piracy market, and in some regions, even fosters a grey market industry, exacerbating the difficulties of digital copyright protection. Piracy not only undermines the healthy development of the digital product market but also dampens the creative enthusiasm of creators. When works meticulously crafted by creators are wantonly pirated, their income and reputation suffer severe damage. In such an environment, many potentially excellent creators might abandon their work due to insufficient returns, leading to an immeasurable negative impact on the entire cultural industry. While blockchain technology holds great promise, it still faces numerous challenges at this stage in addressing the issue of piracy. Advancements in technology must be accompanied by concerted efforts in legal frameworks and user education to truly establish a robust and orderly digital copyright protection ecosystem.

3.2. Copyright ownership disputes

Disputes over copyright ownership represent a significant challenge in the realm of digital product protection, a challenge that has become even more pronounced in the fast-paced digital era where creation and dissemination occur at unprecedented speeds. The immediacy and widespread reach of publication have rendered the determination of copyright ownership increasingly complex. Instances arise where multiple creators may produce similarly themed works within a comparable timeframe or where collaborative efforts give rise to disputes over ownership, thereby complicating the adjudication of copyright claims. Traditional methods for establishing copyright ownership, such as copyright registration and legal arbitration, often entail prolonged durations and considerable costs, rendering the dispute resolution process both cumbersome and resource-intensive [2]. Moreover, when copyright disputes cross international boundaries, legal and cultural differences further exacerbate the difficulty of resolution. These issues not only perplex creators but also impede the commercialization and dissemination of works, thereby hindering the overall advancement of the industry.

3.3. Difficulty in tracking infringement

The challenge of tracking copyright infringement is a significant issue in the realm of digital product protection, particularly exacerbated by the rapid advancement of the internet. Infringers exploit the anonymity and global nature of virtual networks to disseminate pirated content swiftly, making it exceedingly difficult for copyright holders and enforcement agencies to pinpoint the source of the infringement and monitor the illegal activities. This phenomenon not only severely undermines the interests of copyright holders but also diminishes the overall efficacy of copyright protection. Traditional methods of tracking infringement primarily rely on manual monitoring and legal litigation, which are not only time-consuming and labor-intensive but also susceptible to technological and geographical constraints, resulting in suboptimal tracking outcomes. Furthermore, the covert and diverse nature of infringement activities, such as the distribution of pirated content through P2P networks and the dark web, further complicates and intensifies the challenge of effective tracking.

4. Development Path of Copyright Protection for Digital Products Based on Blockchain Technology

4.1. Improvement of Copyright Registration and Tracking Mechanism

In the development path of digital product copyright protection based on blockchain technology, the improvement of copyright registration and tracking mechanism is of great significance. The decentralization and non-tampering characteristics of blockchain technology provide new methods and ideas for copyright protection, and can effectively deal with many challenges in traditional copyright registration and tracking.

4.1.1. Copyright Registration through Blockchain

The traditional process of copyright registration is often cumbersome and time-consuming, involving extensive manual procedures and intermediary agencies. The advent of blockchain technology has the potential to significantly streamline this process. Blockchain, through its distributed ledger technology, enables decentralized data storage, with each node maintaining a complete replica of the database, thus substantially enhancing both security and transparency. Within this technological framework, copyright registration for digital products can be directly executed on the blockchain. Creators merely need to upload their works and digitally sign them on a blockchain platform, where the system automatically generates a unique copyright identifier and records it on the blockchain [3]. This process is not only swift and efficient but also eliminates the potential for human errors and data tampering common in traditional registration methods. Furthermore, blockchain technology offers smart contract capabilities, rendering the copyright registration process more intelligent and automated. Smart contracts can be pre-configured with all conditions and rules for copyright registration, and once the conditions are met, the contract automatically executes the relevant operations. This leads to a more standardized and transparent registration process, greatly enhancing the efficiency and credibility of copyright protection.

4.1.2. Real-Time Tracking of Copyright Usage

In conventional copyright protection models, tracking the usage of copyrights often presents numerous challenges. The covert nature and rapid spread of piracy make it difficult for copyright holders to promptly detect and address infringement. Blockchain technology offers a novel solution to this problem. Through blockchain, every instance of usage, copying, and dissemination of digital

products can be recorded, creating an immutable usage trail. This implies that any unauthorized use will leave a trace on the blockchain, allowing copyright holders to continuously monitor and track the usage of their works. This real-time tracking mechanism not only enhances the effectiveness of copyright protection but also provides copyright holders with greater control and proactive capabilities. They can detect and halt infringement activities promptly based on blockchain data, thereby safeguarding their legitimate rights. Additionally, the transparent records on the blockchain offer robust evidence for legal proceedings, augmenting the legal efficacy of copyright protection. Moreover, the application of smart contracts in real-time tracking of copyright usage holds significant promise. Smart contracts can be programmed to automatically monitor and address infringements, triggering pre-set legal or economic measures, such as issuing warnings to infringers or initiating compensation procedures. This automated management approach not only reduces the costs and time associated with human intervention but also enhances the timeliness and accuracy of copyright protection. In summary, the application of blockchain technology in copyright registration and tracking mechanisms paves new avenues for digital copyright protection. Blockchain-based registration ensures the security and transparency of copyright information, while real-time tracking improves the effectiveness and immediacy of copyright enforcement. Despite the technological and legal challenges still faced in practical applications, the potential of blockchain in copyright protection is undeniably promising. With ongoing technological advancements and gradual refinement of relevant regulations, blockchain is poised to become a crucial tool for safeguarding digital product copyrights, offering creators and rights holders more comprehensive and efficient protection.

4.2. Application of Smart Contracts in Copyright Management

4.2.1. Automated Copyright Licensing and Payment

Traditional copyright licensing and payment processes are often cumbersome and inefficient, requiring substantial manual intervention and the involvement of intermediary agencies. Smart contracts, as self-executing agreements, can autonomously complete the copyright licensing and payment processes based on pre-established conditions and rules, eliminating the need for third-party involvement. This automation not only significantly reduces transaction time but also minimizes errors and costs associated with human intervention. Within the framework of smart contracts, copyright holders can define specific licensing terms, such as scope of use, duration, and fees. Once the user fulfills these terms, the smart contract automatically generates the license and simultaneously triggers the payment mechanism, transferring the appropriate fee to the copyright holder's account. Throughout this process, all transaction details are recorded on the blockchain, ensuring transparency and immutability. This approach not only simplifies the copyright transaction process but also enhances security and credibility. Additionally, smart contracts enable tiered authorization and detailed management [4]. For example, different licensing conditions and fees can be set for various types of usage needs, catering to diverse market demands. This flexibility makes copyright management more precise and efficient, further advancing the development of the digital copyright market.

4.2.2. Design of Smart Contracts for Handling Copyright Disputes

Copyright disputes pose a significant challenge in copyright management, with traditional legal litigation being time-consuming and costly. The introduction of smart contracts offers a new, efficient, and cost-effective solution for resolving copyright disputes. By pre-setting dispute resolution mechanisms within smart contracts, it is possible to automatically initiate the relevant

processes upon detecting a dispute, reducing human intervention and enhancing the efficiency of dispute resolution. In handling copyright disputes, smart contracts can establish various rules and procedures. For instance, upon detecting infringement, a smart contract could automatically trigger an investigation, gather and record pertinent evidence on the blockchain, ensuring the authenticity and completeness of the evidence. Subsequently, the smart contract can adjudicate the infringement based on pre-set rules and enforce corresponding compensation or sanctions. This automated approach not only accelerates the resolution of disputes but also reduces legal costs for both parties. Furthermore, the transparency and traceability of smart contracts provide a safeguard for fair dispute resolution. All parties involved can access transaction and processing records on the blockchain, ensuring that every action is publicly transparent and reducing distrust and disputes in the resolution process. The automatic execution feature of smart contracts mitigates human interference, ensuring the fairness and consistency of outcomes. The application of smart contracts in copyright management not only transforms traditional licensing and payment models but also offers new approaches for resolving disputes. Through automation and intelligent processing mechanisms, it significantly improves the efficiency and transparency of copyright management, providing robust technological support for digital copyright protection. Although the widespread application of smart contracts still faces technological and legal challenges, their potential and value in copyright management are already becoming apparent. With the continued maturation of blockchain technology and the gradual improvement of legal frameworks, smart contracts are poised to become a central tool in digital copyright management, offering more comprehensive and efficient protection for creators and copyright holders.

4.3. Legal and Policy Recommendations

4.3.1. Enhancing the Legal Framework

The existing legal system evidently lags behind in addressing the challenges posed by blockchain technology. The decentralized, immutable nature and smart contract features of blockchain have introduced unprecedented methods of copyright protection, but they also impose new demands on the legal framework. Firstly, the law should clearly define the legal status of blockchain technology in copyright protection, ensuring that copyright registration and smart contracts on blockchain platforms hold legal validity. This would not only safeguard the rights of copyright holders but also enhance the transparency and credibility of copyright transactions. Secondly, as a critical component of blockchain technology, the legal validity and execution mechanisms of smart contracts need to be explicitly delineated. The automated and self-executing characteristics of smart contracts can significantly enhance the efficiency of copyright transactions, but without legal protection, disputes and risks may arise. The law should establish standards for the design and execution processes of smart contracts, ensuring they hold evidentiary value in legal disputes while preventing the creation of unreasonable or malicious contracts. Additionally, privacy protection and data security are crucial issues in blockchain applications. The recording of copyright usage and transaction information on blockchain involves substantial amounts of user data and commercial secrets. The law should prescribe measures for the use and protection of this data to prevent leakage and misuse. Furthermore, a data oversight mechanism should be established to ensure blockchain platforms comply with relevant laws and regulations, protecting the legitimate rights of users and copyright holders [5].

4.3.2. Promoting Policy Support for Blockchain Technology Applications

The government's role in advancing the application of blockchain technology is pivotal. Firstly,

policies should encourage technological research and innovation, providing financial support and technical resources to advance blockchain technology in copyright protection. Establishing special funds and research projects to support the development and experimentation of related technologies will motivate enterprises and research institutions to increase their technological investments. Secondly, pilot programs and promotion are essential methods for advancing blockchain technology applications. Selecting specific regions or industries for blockchain technology pilot applications will accumulate experience and enable gradual promotion. This approach not only aids in the practical verification and improvement of technology but also helps identify and address potential issues. The government can incentivize enterprise participation in pilot projects through tax benefits and financial subsidies, thereby expanding the technology's application. On this foundation, strengthening blockchain technology's promotion and education is also a critical aspect of policy support. Enhancing public awareness and understanding of blockchain technology, and dispelling doubts and misconceptions about new technology, will facilitate its adoption. The government should conduct training, seminars, and other activities to disseminate blockchain knowledge and elevate the technical literacy of both industry professionals and the general public. Additionally, international cooperation and experience sharing are crucial for the development of blockchain technology. Collaborating with international organizations and other countries to share experiences and technologies, and to jointly establish international standards and norms for blockchain technology, will help promote its global application. Finally, the government should establish a comprehensive regulatory system to ensure the legal and compliant application of blockchain technology. Formulating corresponding regulatory policies and measures, enhancing supervision and management of blockchain platforms and applications, and preventing technology misuse and risks are essential. Simultaneously, a risk warning and emergency response mechanism should be set up to promptly address and resolve issues arising from technology applications, ensuring the security and stable deployment of blockchain technology. In summary, the application of blockchain technology in digital product copyright protection holds great promise, but its development requires a robust legal framework and policy support. By clarifying legal status and smart contract validity, protecting privacy and data security, encouraging technological research and pilot applications, improving public awareness and international collaboration, and strengthening regulation and risk prevention, blockchain technology will play a more significant role in copyright protection, providing a solid foundation for the healthy development of the digital economy [6].

5. Conclusion

The advent of blockchain technology presents a novel perspective for the protection of digital product copyrights. By leveraging blockchain for copyright registration and tracking, one can substantially mitigate issues of piracy and disputes over ownership, thereby enhancing both the efficiency and transparency of copyright protection. The implementation of smart contracts further opens the door to automated copyright management, streamlining the processes of licensing and payment. However, blockchain technology still contends with challenges in practical application, including technical complexity, high costs, and legal and regulatory hurdles. Hence, there is a need for continual refinement of relevant legal frameworks and policy support to foster the widespread adoption of blockchain in copyright protection. As technology progresses and applications deepen, blockchain is poised to become the cornerstone of digital copyright protection, safeguarding the robust development of the digital economy.

References

[1] Adams R, Kewell B, Parry G. Blockchain for good? Digital ledger technology and sustainable development

goals[J]. *Handbook of sustainability and social science research, 2018: 127-140.*

[2] Engelmann F, Holland M, Nigischer C, et al. Intellectual property protection and licensing of 3d print with blockchain technology [M]//Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0. IOS Press, 2018: 103-112.

[3] Yu D, Pan T. Identifying technological development trajectories in blockchain domain: A patent citation network analysis [J]. Technology Analysis & Strategic Management, 2021, 33(12): 1484-1497.

[4] Li N, Zhang H, Du R, et al. Blockchain technology and intellectual property protection: a systematic literature review [J]. International Journal of Blockchains and Cryptocurrencies, 2022, 3(2): 112-130.

[5] Schulz K A, Gstrein O J, Zwitter A J. Exploring the governance and implementation of sustainable development initiatives through blockchain technology[J]. Futures, 2020, 122: 102611.

[6] Chen W, Zhou K, Fang W, et al. Review on blockchain technology and its application to the simple analysis of intellectual property protection [J]. International Journal of Computational Science and Engineering, 2020, 22(4): 437-444.