

THE DUAL-EFFECT OF EMERGING TECHNOLOGIES ON INTELLECTUAL PROPERTY RIGHTS IN THE DIGITAL AGE

Qianlan, Bai¹; Zuhong, Gui¹; Su, Hu¹; Bin, Ju¹

¹China Mobile Communications Corporation

ABSTRACT

There are challenges in protecting intellectual property rights (IPR) in the digital age. These challenges undermine the legal protection and economic incentives for innovators. The rise of emerging technologies, notably blockchain and artificial intelligence (AI), presents opportunities to address these issues. The decentralized nature and immutability of blockchain introduce enhanced transparency and security for verification and transactions of IPR. Meanwhile, AI technology, with its advanced data processing and pattern recognition capabilities, has improved the monitoring and identification of infringements, thereby boosting the efficiency of IPR protection. Emerging technologies also bring new challenges to IPR protection. For example, the copyright ownership of AI-generated works, and the regulatory difficulties that blockchain technology may bring while improving transparency. These issues require a collective effort from policymakers, practitioners, and ordinary users to address, through means such as updating legal frameworks and enhancing awareness of IPR. This article explores the current situation and challenges of IPR protection in the digital age, and analyzes the dual role played by emerging technologies. The paper proposes potential solutions to these challenges and emphasizes the importance of technical and regulatory standardization. Through an in-depth analysis of these issues, this article aims to provide suggestions for policymakers, practitioners, and ordinary users to promote the effective protection and rational utilization of IPR, as well as the sustainable development of society.

Keywords - Digital transformation, technological innovation, regulation and standardization, UN agenda for sustainable development

1. INTRODUCTION

With the development and widespread adoption of technologies like the Internet and mobile communications, society has gradually entered the digital age[1]. From the popularity of online shopping and electronic payments, to the implementation of smart cities and telemedicine, to the rise of industrial automation and precision agriculture, all reflect the reshaping of social operating models by digitalization. At the same time, digitalization has also promoted the diversification of information dissemination, making knowledge acquisition and cultural exchanges more open. In addition, the digital transformation in governments and enterprises is enhancing

public service efficiency and business competitiveness[2]. All of this signifies the dawn of a new data-driven era.

At the same time, the development of international information and communication technology (ICT) has significantly enhanced global data sharing and processing capabilities. This advancement has given rise to a new generation of technologies, represented most notably by blockchain and Artificial Intelligence (AI), which in turn has further propelled the digital transformation of society. These technologies have greatly improved the efficiency and security of data processing and brought unprecedented changes to various industries. Blockchain technology[3], with its decentralized nature and the immutability of data records, provides more transparent and secure solutions for fields such as financial transactions and supply chain management[4], thereby enhancing the credibility of data and the reliability of transactions. Meanwhile, AI technology[5] significantly enhances the accuracy of data analysis and decision-making efficiency by emulating human learning, judgment, and problem-solving abilities. It is widely used in medical and healthcare, urban management, personalized education, and customer service[6]. The application of these technologies not only drives the digital transformation across various societal sectors but also facilitates the flow of information and the optimal allocation of resources, accelerating the overall digital process of society.

Technological innovation drives the digitization of society, while the intellectual property rights (IPR) system provides innovators with essential legal protection and economic incentives to ensure they can receive a fair reward for their intellectual achievements[7]. With the rapid development of digital technologies and easy dissemination of information, effective protection of IPR not only helps prevent the illegal reproduction and misuse of creative and innovative results, but also promotes the sharing of knowledge and the rational dissemination of technology. These functions are essential for maintaining a level playing field, encouraging continuous innovation, and fostering economic and cultural growth.

In the digital age, IPR encounter multiple challenges[8]. First, the ease of copying and rapid dissemination of digital content complicates copyright protection, rendering effective monitoring of copyright infringement challenging. Secondly, the diversification of digital content creation and distribution forms complicates the definition of ownership and the management of use boundaries for IPR, with existing protection mechanisms struggling to address these new challenges. Finally, the cross-border nature of IPR in the

digital age complicates law enforcement due to difficulties in legal jurisdiction and international cooperation, making the protection of IPR more challenging.

Emerging technologies, notably blockchain and AI, offer potential solutions to challenges in defining, protecting, and managing digital IPR[9]. Blockchain technology stands out with its decentralized, immutable, and highly transparent features, introducing a novel and reliable method for confirming and utilizing IPR. For instance, storing copyright information of creative content on the blockchain provides copyright owners with incontrovertible and permanent proof of ownership. This approach simplifies the process of verifying copyright ownership and effectively prevents copyright infringement. AI, with its advanced data processing and pattern recognition capabilities, can autonomously detect and identify infringing content online, offering substantial technical support for IPR protection.

However, developing and applying these emerging technologies also pose challenges to IPR management. For example, the widespread use of AI and the creation of AI-generated works have raised complex debates about copyright ownership. There is a lack of clear legal guidance and regulations regarding the attribution and protection of these creative works. Additionally, the use of data in AI training processes poses privacy breach risks[10]. While blockchain technology can enhance the transparency and efficiency of IPR management, its decentralized and tamper-proof characteristics may also present regulatory challenges. Furthermore, compared with traditional technologies, AI and blockchain exhibit more pronounced cross-regional and cross-platform characteristics. Establishing unified regulatory standards to better facilitate their application and thereby promote sustainable development has become an urgent issue.

In this paper, we first introduce the characteristics of IPR in the digital era. Then, using AI and blockchain technology as representatives, the paper discusses the double-edged sword effect of emerging technologies on IPR management in the digital era, including their impact on policy, supervision, law, and society. The impact on all aspects highlights the importance of establishing consistent regulatory rules for the application of emerging technologies especially in the rapidly evolving landscape of these technologies. Finally, this article offers suggestions to policymakers, practitioners, and ordinary users regarding the IPR protection challenges posed by emerging technologies in the digital age.

2. INTELLECTUAL PROPERTY RIGHTS AND EMERGING TECHNOLOGIES IN DIGITAL AGE

In this section, we introduce the characteristics of IPR and emerging technologies in the digital age.

2.1 IPR system in the digital age

The IPR system is key to ensuring that innovations are recognized legally and utilized properly[8]. The development of digital technology has not only changed how knowledge is created, disseminated, and consumed but also has had

a profound impact on the definition, use, protection, and management of IPR.

First, digitization poses new problems for the definition of IPR. While the traditional legal system of IPR is based on physical media and priority of dissemination, works can be reproduced and disseminated without loss or limitation in the digital environment. This ease of reproduction complicates the definition of an original work, as the criterion of "originality" of an original work becomes blurred in digital reproduction. During the digital creation process, the author's novel ideas, revision process and other creative activities are often hidden, unlike in traditional media where visible traces are easily left behind. This makes it difficult for third parties to judge whether a digital work is truly original.

Secondly, digitization poses new challenges to the protection of IPR. Digital works are distributed in various ways, and the illegal downloading and sharing online of digital works exacerbates the issue of IPR infringement. The anonymity and borderless nature of cyberspace make such infringements more covert and difficult to trace, which allows infringers to easily conceal their identities. The traditional intellectual property protection measures are often ineffective in a digital environment. With the advancement of emerging technologies like big data and the Internet of Things, the protection of IPR is no longer limited to traditional patents, trademarks, and copyrights, but extends to new types of IPR such as software codes, algorithms, and data sets. At the same time, the development of digital society has shortened the cycles of innovation and application, placing higher demands on the efficiency of IPR protection. Establishing a more efficient dispute resolution mechanism and services to resolve IPR disputes is an important task for the protection of intellectual property rights in the digital age.

Table 1 – The development of online literature in China in 2023[22].

	Number	Year-on-year growth
Author	24.05 million	10.32%
Literature	36.2 million	13.13%
User	537 million	9%

Finally, the trans-regional nature of IPR is more pronounced in the digital age. Digital technology allows for the rapid global access and use of works. Through the internet, works can be instantly disseminated worldwide. Music, movies, books, and software can all be obtained by countless users through digital platforms, providing users with a more flexible and convenient experience. Taking the Chinese online literature market in 2023 as an example, as shown in Table 1, the current online literature market is vast and shows a steady growth trend. The emergence of online book and music platforms such as Migu Reading and Migu Music has made it more convenient for the public to access and use works protected by IPR. This has not only changed the way works are disseminated but also promoted the development of new business models based on IPR. For instance, subscription services, in-app purchases, and content sharing platforms are all new business models enabled by digital technology, providing new sources of revenue for creators and owners of IPR. Furthermore, digitalization has lowered the barriers

for users to participate in the creation and dissemination of IPR. Users can now share their creations and engage in the spread and use of IPR through social media, blogs, video platforms, and other channels. The transformation of these usage methods has put forth new demands on the licensing and distribution mechanisms of IPR.

2.2 Emerging technologies change industry and life

The recent advancements in information and communication technology (ICT) have substantially enhanced our ability to process and share information, thereby providing a strong foundation for the growth of new technologies. Specifically, as ICT has evolved, the delay in data transmission has been greatly reduced, making real-time communication a reality. This development is particularly crucial for emerging technologies like AI, which depends on instant analysis and decision-making in some application scenarios, and blockchain, which requires distributed verification across networks. The advancement of these technologies further influences and speeds up the innovation process.

AI technology, with its robust data processing and machine learning capabilities, is increasingly being integrated into various sectors, including healthcare, finance, and transportation, thereby enhancing work efficiency. In industrial production, AI optimizes production processes through precise data analysis and prediction. For example, Germany's Industry 4.0 strategy integrates AI technology to achieve automation and intelligence in production lines, making the process more adaptable and efficient. In agriculture, AI is revolutionizing traditional farming methods; intelligent robots can detect crop diseases and pests, applying pesticides with precision. Blue River Technology's agricultural robot, for instance, can identify and selectively spray individual plants, thus minimizing the use of chemical pesticides and protecting the environment. In the retail sector, AI technology has enhanced the customer shopping experience through personalized recommendation systems. Amazon utilizes big data to analyze customers' purchase history and preferences, recommending products to them and improving sales efficiency. Meanwhile, in transportation, autonomous driving technology heralds a revolution in future mobility. Tesla's Autopilot system facilitates autonomous driving by integrating advanced sensors with AI algorithms, thereby enhancing road safety and reducing traffic congestion. As a distributed ledger technology, blockchain is gradually revolutionizing the operations of many industries through its unique features: decentralization, immutability, transparency, and smart contract functionality. In public services, blockchain is enhancing the efficiency of departmental services. China Mobile and China Unicom have created settlement chains based on CMChain and Unicom Chain respectively, which are tailored to the settlement business scenarios of operators. This initiative has broken down barriers to data circulation between operators, enabling fair, error-free, and automated data exchange, auditing, and settlement between different operators. It reduces human intervention, ensures data security, and

lowers the costs of trust and operation. In healthcare, blockchain is enhancing the management and protection of patient data. The blockchain-based regional diagnosis and treatment platform, co-developed by China Mobile Zijin Innovation Research Institute and Jiangsu Provincial People's Hospital, has bridged the data silos across hospitals, enabling seamless information connectivity. This allows alliance institutions to share patient diagnosis, treatment, and medication information securely, without compromising patient privacy, thereby offering improved diagnostic and treatment services to patients.

These cases show that emerging technologies such as AI and blockchain are changing society, improving production efficiency and service quality, and enriching life experiences. In the process of development and application, these technologies have also produced many new IPRs, including patents, Copyrights, and business secrets, but also produced many new application scenarios, increasing the complexity of the definition and protection of IPR. In addition, compared with traditional applications, the cross-regional and cross-platform characteristics of blockchain and AI applications are more obvious and common, which means that IPR management requires stronger multi-party cooperation. Therefore, the IPR system needs to adapt to the pace of innovation and formulate more complete and international laws, regulations, and technical standards to effectively protect innovative achievements in these emerging fields.

3. POSITIVE EFFECTS OF EMERGING TECHNOLOGIES ON IPR PROTECTION

Emerging technologies offer potential solutions to many of the challenges facing IPR in the digital age.

3.1 Emerging technologies help authentic IPR

The traditional IPR management system is often confronted with a multitude of challenges pertaining to the rights confirmation process. The first of these is the issue of efficiency. The traditional rights confirmation process is cumbersome and time-consuming, especially when it involves cross-border registration and management. Secondly, due to the centralized storage of records, there is a risk of tampering or loss, which may lead to uncertainty in proof of ownership. Furthermore, existing copyright verification mechanisms frequently lack sufficient transparency, rendering it challenging for the public to verify the copyright status of a work. Concurrently, the existing rights confirmation mechanism is relatively expensive. For instance, in China, the average fee for each IPR registration exceeds 68.9\$ [12], which makes many copyright owners give up registering copyrights.

The integration of blockchain technology into IPR represents a significant shift from traditional IPR management methods. This technology offers a decentralized, transparent, and immutable system for data recording, presenting an affordable, highly secure, and reliable approach to affirming IPR. This technology facilitates the establishment of a distributed, globally accessible database for intellectual

property, where the registration details of each intellectual property item are securely logged and preserved. One notable instance of blockchain technology in IPR authenticating is the KODAKOne[13] platform, which employs blockchain to deliver a digital rights management system for photographers and visual artists. Artists can register their creations and securely log the metadata of their work, including the time and place of its creation. The recorded information is irreversible, thereby providing robust proof of the artists' copyright.

In terms of music copyright protection, the "Creative Passport"[14] digital identity platform, initiated by British singer Imogen Heap, furnishes music creators with an innovative mechanism for managing their works and copyrights. Creative Passport utilizes blockchain to assign a distinct digital identity to each artist, encompassing the artists' personal information, a catalog of creative works, copyright details, and records of licensed work usage. It capitalizes on the decentralization of blockchain to authenticate music creators' identities, ensuring their authenticity and uniqueness and leverages smart contract technology for the automated implementation of copyright licensing and revenue distribution. The smart contract divvies up revenue among artists and other rights holders based on predefined regulations, streamlining the distribution process and minimizing intermediaries. This provides a transparent and credible source of copyright and corroboration information, making it easy to verify the originality and ownership of works. At the same time, through blockchain technology, every licensed use and transaction of a work can be tracked and recorded, which provides strong evidence for copyright disputes and allows artists to better control their works.

Ant Chain and Tencent Blockchain, the two blockchain platforms of China's tech giants, have also started offering copyright verification services at competitive prices, with fees as minimal as 0.1378\$ and 0.4114\$ per verification, respectively. This service allows content creators to log their work details on the blockchain, creating an unalterable digital certificate that bolsters the verifiability and protection of copyright.

3.2 Emerging technologies facilitate IPR management

Contrasting with traditional intellectual property access models, the electronic management of IPR in the digital age, characterized by the use of electronic databases and online systems for record-keeping, can be significantly enhanced through the application of AI technology. This enables the analysis of IPR data to assist businesses and individuals in identifying technological trends, potential partners or competitors, as well as intellectual property risks. Such insights support the formulation of more informed decisions and contribute to long-term strategic planning. The PatentSight platform[17] uses AI to assess the quality and impact of patents relative to others in their field, analyze competitors' patent portfolios, and aid companies in understanding patent landscapes in the industry. PatentSight helps companies and institutions to make well-informed IPR

management decisions, optimize patent strategies, protect innovations, and secure a competitive edge.

In response to the frequent incidents of infringement caused by convenient sharing and downloading in the digital age, AI technology offers potential solutions. With its unique data analysis and processing capabilities, AI can analyze vast amounts of text, images, audio, and video content, significantly enhancing the identification and tracking capabilities of copyrighted works. For instance, Pixsy utilizes AI technology to scan the internet for unauthorized use of images and offers copyright claim services. This empowers artists to track the global usage of their works, safeguard their copyrights, and ensure they receive fair compensation for their creations.

In addition, emerging technologies are facilitating the legitimate use and sharing of content. The complexity of managing copyrights in traditional IPR usage significantly slows down the licensing process, particularly regarding fair use and content sharing, which often requires substantial time and costs. This situation hinders innovation and the free flow of knowledge. However, the integration of blockchain technology into IPR management has markedly enhanced the authorization and utilization of copyrighted works. Smart contracts, which are computer programs that automatically execute and regulate events or actions, operate on blockchain platforms. In IPR usage, smart contracts can be set to automatically enforce copyright licensing agreements once specific conditions are fulfilled, streamlining the licensing process, reducing transaction costs, and increasing transparency and trust. For instance, the Ujo Music platform[15] leverages the Ethereum blockchain to manage music copyrights and automate royalty distributions. Artists can upload their music to Ujo Music and establish smart contracts that dictate sharing terms and usage conditions. Users must adhere to the smart contract provisions, such as paying a fee, to access or use these works. Upon meeting the transaction conditions, the smart contract executes automatically, granting access to the work and directly distributing royalties to artists and other rights holders without third-party intermediaries.

Moreover, blockchain technology fosters innovative copyright usage models, like subscription or micropayment models, encouraging fair use and content innovation. Its decentralized nature diminishes dependence on traditional intermediaries, like payment processors and content distribution networks, lowering transaction costs and enhancing payment efficiency. The transparency and immutable records offered by blockchain technology foster greater trust between content creators and consumers. Every content usage and payment transaction can be recorded and verified, ensuring equitable copyright fee distribution. This approach enables the creation of personalized and flexible copyright licensing models. Using smart contracts, copyright owners can devise various licensing rules as needed, offering more profit models for copyright owners and more choices for consumers. The Brave browser[16] utilizes blockchain and the Basic Attention Token (BAT) to introduce a new content payment and ad revenue sharing mechanism, rewarding users

with BAT tokens for ad viewing and enabling them to support their favorite sites and content creators. This model encourages user engagement and offers content creators a new revenue source, reducing reliance on conventional advertising models. Steemit has developed a blockchain-based social media and content-sharing platform, rewarding users with cryptocurrency for posting, commenting, and promoting content, thus creating a decentralized content ecosystem where content value is directly determined by the community, ensuring fair compensation for creators.

4. INTELLECTUAL PROPERTY RIGHTS CHALLENGES IN EMERGING TECHNOLOGY

Artificial intelligence and blockchain technology present a series of challenges to IPR, affecting its definition, protection, and management[11].

4.1 Emerging technologies impact traditional IPR concepts

Emerging technologies introduce novel application scenarios that challenge the traditional concepts and practices of IPR. Traditionally, the IPR system has protected works and inventions created by humans. However, AI systems can autonomously generate original content such as literature, music, and art by analyzing vast amounts of data and mimicking human creativity. This situation presents challenges to the current understanding of IPR, as there are no explicit regulations regarding how works and inventions created by AI systems should be protected. For instance, AI-generated trademark designs question the traditional mechanisms for trademark registration and protection, particularly concerning the criteria for originality and distinctiveness. Additionally, the definition and protection of IPR for insights and decision-support information generated through AI data analysis, and the protection of these data-driven innovations, challenge existing protection mechanisms. For example, the analysis results obtained from using data to analyze and predict consumer behavior are currently uncertain as to whether they can be eligible for copyright or patent protection.

On the other hand, as the core of AI, many AI algorithms and models are essentially mathematical formulas or data processing methods. Although the patent examination policies for AI algorithms in major countries or regions around the world vary, the basic principle is consistent: pure algorithms cannot be directly protected by patents.

In addition, the innovations of AI systems may depend on data and information from multiple sources. The emergence of such intelligent creation prompts a reevaluation of traditional concepts like creator identity and copyright ownership. In scenarios where an AI service platform and a user providing creative input both contribute to the creation, determining the ownership of IPR becomes more complex and ambiguous. Traditional copyright laws struggle to ascertain the ownership of AI-generated works and to balance the creative freedom of AI systems with public rights and interests.

The emergence of non-fungible token (NFT) artworks,

powered by blockchain technology, not only signifies the fusion of technology and art but also poses new challenges to existing IPR laws[23][24]. Unlike traditional art, where purchasing equates to owning the physical original, owning an NFT artwork relates only to a link, with the purchase representing control over a digital copy. This control mainly includes access and display rights, and does not include the right to physical possession and exclusive use of the work. Consequently, the trade of NFT artworks has sparked extensive debates on the property rights definition of digital works. Another characteristic of NFTs is their divisibility through smart contracts, splitting an artwork into several parts, each linked to the original. Whether these divided segments retain the original artistic value and originality becomes a pertinent issue, challenging copyright law, especially regarding defining and protecting the originality and copyright of these digital segments.

4.2 Emerging technologies challenge IPR protection

Compared with traditional software patents, AI algorithm patents present a greater challenge for infringement detection. AI algorithms often encompass intricate mathematical models and data processing techniques, with their abstraction and lack of transparency making direct detection of infringement particularly difficult. Infringement can be obscured by modifications such as altering the algorithm's implementation, adjusting its parameters, or manipulating the input and output data. Furthermore, the application of AI algorithms is extensive and diverse, allowing infringers to deploy them across different domains or embed them within complex systems, thereby concealing the infringement across a multitude of application scenarios. However, the existing IPR legal framework may not be fully adapted to the characteristics of AI technology, leading to uncertainties in the determination of infringement and the application of law. Furthermore, the ambiguity surrounding the definition and ownership of IPR in the context of AI, coupled with the anonymity inherent in blockchain technology, complicates the application and enforcement of IPR laws.

Unauthorized use of existing data for AI learning processes may lead to outputs that replicate original expressions, potentially constituting copyright infringement. Given that input materials often derive from vast and diverse datasets, identifying the copyright owner for each piece of content and obtaining authorization becomes exceedingly difficult. Existing authorization mechanisms lack guiding principles and methodologies for large-scale automated processing and utilization. Moreover, the complexity and uncertainty surrounding AI systems complicate the determination of legal liability and compensation in cases of infringement. Questions arise as to who bears responsibility: the developers and operators of the AI system, the AI system itself, or its users? This requires a thorough review and regulation of the legal responsibilities associated with AI technology.

The anonymity inherent in blockchain technology significantly complicates tracking and identifying infringers. While transaction records on blockchain platforms are

public and transparent, participants' true identities are often obscured through encryption. Consequently, even if an IPR owner identifies records of illegal copying or use, pinpointing the infringer's specific identity for direct legal action becomes challenging. This issue is particularly acute in cross-border transactions, where varying legal recognitions and regulatory standards for blockchain technology complicate the cross-border protection and enforcement of IPR. From an evidence collection standpoint, the anonymity on the blockchain also poses challenges to gathering and verifying evidence in copyright infringement cases. Although transaction records are immutable, the anonymity of the parties involved makes it difficult to link transaction activities to specific individuals directly. This not only increases the complexity of IPR infringement litigation but also escalates the cost of legal enforcement.

4.3 IPR management challenges posed by emerging technologies

The development of AI, driven by data, poses challenges for users to data privacy and security. In the AI context, data is not merely an information carrier but also a valuable asset and resource. However, the existing IPR legal framework, which primarily focuses on traditional creative works, leaves gaps in data protection and the generated AI models. Regarding data privacy, the training and application of AI necessitate collecting vast amounts of data, including personal information, behavioral habits, and transaction records of users. Collection and usage of this data without user consent or beyond their expectations may infringe upon privacy rights. The opaque decision-making processes of AI systems, known as their "black-box" nature, heighten concerns about personal data usage. Moreover, the international flow of data introduces complexity due to varying data privacy protection requirements across different legal jurisdictions worldwide. Regarding IPR challenges of data, the widespread adoption of AI technology raises pressing questions about data ownership, usage rights, and utilization methods. Smart contracts, self-executing contracts with the terms written into the code, challenge traditional legal frameworks by raising questions about jurisdiction, enforceability, and the role of intermediaries. The decentralized and cross-border nature of blockchain complicates jurisdiction determination. Unlike traditional legal systems that depend on specific geographical and legal jurisdictions for contractual dispute resolution, smart contracts operate globally without geographical restrictions, complicating the applicable law and jurisdiction in disputes. Varied interpretations and applications of smart contracts and IPR laws across different countries and regions add complexity to cross-border protection and dispute resolution. The decentralized nature of blockchain reduces dependence on centralized authorities but complicates seeking legal remedies in cases of IPR infringement or contract disputes. Without centralized organizations, copyright owners must identify infringements and pursue rights protection through legal avenues independently, increasing the difficulty and

cost of rights protection. In traditional intellectual property transactions, intermediaries such as lawyers and copyright agents not only provide professional services but also coordinate the interests of all parties to ensure that the rights holders' interests are effectively protected and the transactions proceed smoothly. However, in the absence of a centralized institution, copyright owners need to confront potential infringers directly. This increases the difficulty of rights protection and raises the cost of enforcement.

The principle that "code is law" in smart contracts means contract execution relies entirely on pre-set code. This mechanism reduces human error and delays, enhancing transaction efficiency. However, risks arise in smart contracts' writing and execution. Most people may lack the capability to comprehend complex smart contract codes, providing an opportunity for malicious actors to exploit by embedding hidden clauses, potentially harming the rights and interests of copyright owners or contract parties. For instance, a digital art transaction via a smart contract might include conditions for automatic ownership transfer, deliberately set to be obscure or hidden, making it difficult for ordinary users to understand. If users do not fully grasp the contract, they may unknowingly lose control over purchased digital artworks, leading to economic losses.

5. APPLICATION OF EMERGING TECHNOLOGIES IN IPR PROMOTE UNITED NATIONS SUSTAINABLE DEVELOPMENT

The rapid development and widespread application of AI and blockchain technologies have demonstrated significant potential in contributing to the United Nations Sustainable Development Goals by promoting the commercialization of IPR and innovating the commercialization models of IPR. Blockchain and AI provide a more convenient and effective platform for the implementation of other IPRs in different regions, enabling more people to benefit from these innovative outcomes. However, to fully tap into this potential, it is crucial to ensure the comprehensive development of information and communication infrastructure, establish and refine relevant technical and regulatory standards, adhere to principles of openness and inclusiveness, and promote compatibility across different platforms, countries, and regions. The improvement of relevant standards will enable technology and services to transcend geographical and socioeconomic barriers, benefiting a broader range of users.

5.1 Emerging technologies narrow the digital divide

In the digital age, marked by the swift evolution and widespread adoption of information and communication technology, the issue of the digital divide has intensified, exacerbating social inequality. The digital divide encompasses not only unequal access to technology but also disparities in skills, knowledge, the ability to utilize technology effectively, and the capacity to reap benefits from the digital economy. This gap is a global phenomenon, affecting countries and various social groups within countries, particularly in developing regions and low-income areas,

where its consequences are profoundly impactful. AI and blockchain technologies offer promising avenues to address and mitigate these issues by facilitating access to open-source resources, thereby enriching education and scientific research resources and making them more accessible. Google's AI educational tool, "TensorFlow", an open-source machine learning library, equips researchers and developers worldwide with potent tools, regardless of whether they are from developed or developing countries. Such open-source tools render technology and knowledge dissemination boundless, aiding in narrowing the digital divide across different regions and social strata.

Blockchain technology, with its decentralized and secure framework, promotes knowledge sharing, collaborative research and development, and the rapid application of new discoveries. Gitcoin[18], a blockchain-based open-source platform, connects developers, designers, and creators to enhance openness and collaboration in software projects. It employs smart contracts to manage task bounties, fundraising, and rewards, thereby encouraging community engagement in open-source projects. By offering a transparent and reliable platform, Gitcoin reduces collaboration hurdles, enabling developers to work together beyond geographical limits and fostering open innovation. Ocean Protocol[19], a blockchain initiative designed to unleash the value of data and facilitate data sharing and reuse, provides a secure and transparent platform for data providers and consumers. Utilizing blockchain technology to secure data usage rights and transaction records, Ocean Protocol reassures data owners about the safe sharing of their datasets, promoting cross-industry data collaboration and propelling AI and other data-centric innovations.

5.2 Emerging technologies promotes quality education

While the digital era has made knowledge more accessible, reducing educational disparities to some extent, students' abilities and self-study capacities still vary significantly across different regions. AI technology introduces a new paradigm for the commercialization of knowledge. For instance, personalized learning platforms can tailor teaching content and methods to individual students' learning habits and progress. A prime example is the Knewton platform[20], which utilizes AI to analyze students' learning behaviors and achievements, customizing teaching content and difficulty to match each student's unique needs and pace. The platform employs machine learning algorithms to process students' interaction data, such as answer accuracy, study time distribution, and question difficulty, pinpointing their strengths and weaknesses. Utilizing this data, the platform recommends the most appropriate learning materials for students' current skill levels and anticipates potential learning obstacles. By offering each student a tailored learning journey, the Knewton platform not only pioneers a new economic model for the commercialization of IPR but also significantly reduces the educational gap between students. By delivering personalized learning experiences and optimizing educational resource distribution, we aim

to enhance the accessibility and quality of educational resources, especially in under-resourced areas. This approach contributes to promoting educational equity and achieving the United Nations Sustainable Development Goals' quality education targets.

5.3 Emerging technologies enhance health and well-being

The integration of AI technology in the medical and healthcare sectors, such as improving the accuracy of disease diagnosis through deep learning and developing personalized treatment plans, is helping people in underdeveloped regions to treat diseases. A notable instance is the Peek Vision project[21], which exemplifies the use of AI in healthcare. This initiative leverages smartphones and AI technology to enhance eye care services in underserved regions. Peek Acuity, an application developed by the project, enables non-specialist individuals to conduct vision screenings and preliminary diagnoses using smartphones. By analyzing users' vision test results with AI algorithms, it suggests further treatment options or professional eye examinations. The project significantly enhances access to eye care for people in disadvantaged areas by offering a portable, affordable, and user-friendly vision screening tool, thus enabling early detection and treatment of eye diseases and preventing numerous cases of avoidable blindness.

Furthermore, Peek Vision aids local health authorities and organizations in more efficiently allocating eye care resources and improving service delivery through data collection and analysis. Beyond directly enhancing the health of residents in impoverished regions, the Peek Vision project serves as a successful model for employing AI technology to address global health challenges. It demonstrates how the application of AI in IPR can enhance access to medical services, reduce costs, and facilitate the efficient allocation of medical resources, contributing to the achievement of the United Nations Sustainable Development Goals related to health and well-being.

6. OUTLOOK AND RECOMMENDATIONS

The development of AI and blockchain has presented new challenges and opportunities to IPR systems. To fully realize the value of these technologies, all parties need to collaborate to improve the existing IPR management framework.

Those responsible for formulating policy must have a profound understanding of the characteristics of AI and blockchain technologies and their impact on IPR. It is imperative that they formulate guiding principles for the protection of IPR in the context of AI innovations. They must clarify the copyright ownership of AI-generated content and provide guidance on patent applications for AI algorithms and machine learning models. Additionally, consideration should be given to the protection of data rights. With regard to blockchain technology, it is essential to address potential legal challenges, including the legal status and validity of smart contracts, as well as the definition and protection of new IPR, such as NFTs, created through blockchain. Given

the global and cross-platform nature of AI and blockchain technologies, policymakers should encourage data sharing and cross-border cooperation while ensuring data privacy and personal information security. They should participate in international discussions and promote the establishment of cross-border IPR protection mechanisms and standards. In this aspect, the ITU should play a leading role. At the same time, support the ethical use and development of AI technology, ensure that its application does not infringe on public interests, and protect the rights and interests of traditional creators and small businesses.

Policy implementers should promote the digital registration and management process of IPR and use blockchain technology to improve the security and efficiency of the process. They should explore the use of AI technology to improve the efficiency of IPR supervision, such as using AI tools to monitor online infringements and automate registration and appeal processes. At the same time, law enforcement personnel will be trained to improve their understanding of AI technology and its application in the field of IPR.

When ordinary users enjoy the convenience brought by emerging technologies, they should also increase their awareness of IPR and understand the copyright and patent issues that may be involved in emerging technologies applications. When using AI technology or AI-generated content, they should ensure compliance with legal regulations and avoid infringement. When purchasing or creating digital assets such as NFT, they should pay attention to relevant IPR issues to ensure legal use and commercialization.

In summary, AI and blockchain technologies provide new tools and possibilities for IPR protection, but they also bring new challenges. Policymakers, implementers and ordinary users all need to adapt to these changes and jointly promote the development and improvement of the IPR protection system.

REFERENCES

- [1] Regnerová, Olga Regnerová-Marta. "Lifestyle changes and shopping behavior in the digital environment.", 2017.
- [2] Wandaogo, Abdoul-Akim. "Does digitalization improve government effectiveness? Evidence from developing and developed countries." *Applied Economics* 54.33, pp. 3840-3860, 2022.
- [3] Nakamoto, Satoshi. "Bitcoin: A peer-to-peer electronic cash system.", 2008.
- [4] Maesa, et al. "Blockchain 3.0 applications survey." *Journal of Parallel and Distributed Computing* 138, pp. 99-114, 2020.
- [5] Jackson, Philip C. *Introduction to artificial intelligence*. Courier Dover Publications, 2019.
- [6] Lu, Yang. "Artificial intelligence: a survey on evolution, models, applications and future trends." *Journal of Management Analytics* 6.1, pp.1-29, 2019.
- [7] Sukarmijan,et al. "The importance of intellectual property for SMEs; Challenges and moving forward." *UMK Procedia* 1, pp. 74-81, 2014.
- [8] Adams, Racheal. "The Evolution of Intellectual Property Rights in the Digital Age." *Journal of Modern Law and Policy* 3.2, pp. 52-63, 2023.
- [9] Singh, B. P., et al. "Blockchain technology and intellectual property rights." *Journal of Intellectual Property Rights*, pp. 41-44, 2019.
- [10] Zakir, Muhammad Hamza,et al. "The Impact of Artificial Intelligence on Intellectual Property Rights." *International journal of human and society* 3.4, pp. 312-319, 2023.
- [11] Yu, Xiang, et al. "Challenges of artificial intelligence to patent law and copyright law and countermeasures." *The Future of Intellectual Property*. Edward Elgar Publishing, pp. 150-168, 2021.
- [12] jiaofeizhinan 2023: https://ggfw.cnipa.gov.cn/PatentCMS_Center/uploads/1/file/public/202311/jiaofeizhinan.pdf
- [13] KODAKOne 2018: <https://www.kodak.com/en/company/press-release/blockchain-initiative/>
- [14] Creativepassport 2023: <https://www.creativepassport.net/>
- [15] Ujo Music 2019: <https://blog.ujomusic.com/?gi=636c76137a09>
- [16] BAT 2023: <https://brave.com/category/bat-creators-brave-rewards/>
- [17] PatentSight 2024: <https://www.lexisnexisip.com/solutions/ip-analytics-and-intelligence/patentsight/>
- [18] Gitcoin 2024: <https://www.gitcoin.co/>
- [19] Ocean Protocol 2023: <https://www.binance.com/zh-CN/square/post/1148634>
- [20] Knewton Personalizes Learning with the Power of AI 2021: <https://d3.harvard.edu/platform-digit/submission/knewton-personalizes-learning-with-the-power-of-ai/>
- [21] Peek Vision 2024: <https://peekvision.org/>
- [22] Research report on the development of Chinese Internet literature in 2023: <https://baijiahao.baidu.com/s?id=1792124501335241800&wfr=spider&for=pc>
- [23] Tang Zhaoxia. "Research on Copyright Protection of NFT Works of Art from the Perspective of Blockchain", Master's thesis. Anqing Normal University, 2023.
- [24] Yu Qigao. "Research on digital copyright protection from the perspective of blockchain technology", Master's thesis. Jiangxi normal university, 2023.