International Core Journal of Engineering Volume 5 Issue 9, 2019
ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

Blockchain Technology and Intellectual Property Protection

Li Zhang

School of Economics and Management, Xidian University, 266 Xinglong Section of Xifeng Road, Xi'an, China

Abstract

With the rapid development of information technology, many products and services are now digitized, and some of these require intellectual property protection (IPP). In absence of reliable and versatile IPP solutions, various problems have arisen regarding digital tampering and verification. We propose in this paper that insights from social informatics about the features available in the blockchain technology could help technologists design and develop safer digital IPP systems. We analyze the background of unclear ownership, data tampering and digital work abuse problems in the digital age, and summarize the relevant literature, showing how blockchain technology can provide solutions within the domain of social informatics. We next explain blockchain technology and its current applications, with particular attention to IPP. Then we show evidence of the feasibility of the application of blockchain technology in the field of intellectual property through a systematic literature review. Finally, we discuss the blockchain potential for data-driven intellectual property management in terms of registration verification and protection in online markets. These include, for example, books, supermarkets, tickets, medical and academic records, provision of scientific datasets, media (music art, video) and intellectual property. The paper concludes by highlighting major research gaps that could be tackled through blockchain technology.

Keywords

Blockchain Applications; Intellectual Property Protection.

1. Introduction

Digitization has become an overwhelming trend in the Web 2.0 era with the rapid development of information technology. Nowadays, we can clearly see that many products and services have been digitized. These include, for example, books, supermarkets, tickets, medical and academic records, provision of scientific datasets, media (music art, video) and intellectual property. Revenue from emerging creative digital cultural products, including movies, television dramas, animation recreational products, blog/twitter and literary fiction, reached 8.0314 trillion Yuan in 2016 (equivalent to €1.03 trillion on 24 Dec. 2017). This growth is predicted to increase, as the digital market for products and services continues to expand worldwide (Ink Chain White paper, 2017). However, such high-speed development has brought increasing challenges for the cultural industry such as unclear ownership and data authenticity, which has caused various types of digital abuse. These issues have been occurring in parallel with the increasing demands for intellectual property protection (henceforth IPP), management tools and encouragement of users to participate in online activities to produce data at an unprecedented rate in "Science 2.0"[1]. Under such conditions, it is difficult to monitor data infringement, check resource authenticity and protect intellectual property rights. These significant obstacles may impact the overall pace, quality and value of digital products and services.

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

Many businesses and non-commercial online organizations in our current digital society are encouraging users to share some or all of their individual data freely. This is creating an online atmosphere where users often see data access as a demand-driven rather than supply-driven behavior [2]. Data-sharing movements depend on platforms that are well-managed so that users actually see the usefulness of storing and sharing their data[3]. In this paper, we argue that society is in need of a versatile IPP technological framework that would ensure online authenticity and safe storage for content creators and providers to devote time, effort, and labor to create new products and services in a decentralized manner. Innovations in digital technology will remain a double-edged sword as new products and services can provide society with both good and bad opportunities. One way to tackle potential issues regarding online reliability is to ensure resource authenticity.

Kleine (2015) [4]suggested that social informatics can help technologists design and develop more appropriate systems to tackle some social problems. R. Lakhani, Bo Jeppesen, A. Lohse, & A. Panetta (2006)[5] Studied this issue further and expressed concern about the little protection currently available to online providers of products and services. Both commercial and non-commercial hosts face similar difficulties regarding the reliable provision of cost-effective solutions for distributed user authentication and distributed resource validation. Some of those IPP-related issues could be mitigated via the application of blockchain technology, as a safely distributed database that can facilitate notarization (i.e. proving data authenticity and legitimacy). Blockchain is a technology that allows for setting a globally distributed database with immutable and openly accessible entries, elements that help setting up trust in a distributed network. IPP is taken hereby as an example where every content creator would be a node in the blockchain network, where both users and resources are securely authenticated. Transactions between nodes can also be recorded into a blockchain, providing reliable traceability across the participants, which is an important missing feature of many current distributed digital platforms.

The focus of this paper is to discuss the potential contribution to bridging the gap regarding difficulties surrounding IPP and the overall increasing need for a solution for digital products and services to provide reliable online access to non- tampered records.

2. The blockchain technology and its application in IPP

A blockchain is a distributed database system involving nodes that can store transactions, such as those originating in digital crypto-currencies (e.g. Bitcoin), or any other transaction such as information about debt, copyrights, equity and digital assets. Information stored in a blockchain cannot be easily forged and tampered with, as that would involve individual approval of every distributed node. This greatly increases the cost of a single node tampering with online data and, as a consequence considerably reduces the cost of a single node in the blockchain to trust and verify the authenticity of an online resource. This is achieved via the following main components of a blockchain, these being a:

hash, mapping resources to unique indexes using one-way mathematical functions;

digital signature, which is implemented using a public cryptographic key;

peer-to-peer network, serving as a route structure for nodes using distributed hash;

consensus mechanism, which is a set of digitally automated procedures that ensure the accuracy and consistency of the stored information across the participating nodes.

In a blockchain, each block is technically composed of a head and a body, storing its version number, the address of the previous block, the current block's target function, work proof and consensus data such as timestamp and the Merkle root information. The latter is part of the tree data structure used to store information using the unique hash values of a blockchain[6]. These blockchain technology features are suitable for digital scenarios involving strict requirements of transaction traceability and authenticity checking, hence lending itself useful to check and enforce regulations. Current centralized database systems may present issues regarding trust due to the high verification costs

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

regarding resource availability and authenticity. For distributed service provision and distributed resource storage, application scenarios include:

middleware between the blockchain platform and client application services. These may include smart contracts, software development toolkits and other digital services;

distributed provision of databases and services in various industries. These may include finance (e.g. online payment, financial services, asset digitization), cyber security (e.g. authenticity of identity and data), supply chain (e.g. logistics tracking).

At present, the rapid development of blockchain applications is arguably being popularized through applications in the financial sector, particularly crypto-currencies [7]. Some authous[8] discuss the application of blockchain technology in IPP as being still in its infancy, yet there is good potential in this area and some ventures have already been created:

Binded. A public blockchain database[9] combining tweeting of copyright entries, aimed at helping photographers to protect their intellectual property.

Teosto. A blockchain platform for tracking and processing payment data[10] regarding royalties for musicians, writers and publishers.

Ascribe. A blockchain platform[11] offering an ownership protocol for digital art, allowing creators to authenticate and notarize their artistic work.

Monegraph. A blockchain platform for digital art[12] and media protection, where content creators safely sell and license their music.

YuanBen. A blockchain enterprise service[13] for certification and trading platform used by the WeChat to enable such services amongst its user's community.

The underlying principles of these venturous IPP platforms are similar, as they are reliant on two key factors. The first one is running an algorithm to generate a unique string for any content. This is called a blockchain hash, which is one layer aiming at preventing the original content from being tampered with. The second one is a verifiable data timestamp. This is aimed at proving the exact time of when the hash has been written to the blockchain. When content creators register their original work (e.g. music, film, poem, book, fiction) on the IPP platform, the hash will help to encrypt the work and the timestamp will be attached to the work entry to help prove ownership according to the content creators. If someone reprints or plagiarizes such work, without permission, the blockchain would allow a complete tracking record back to the original content. Smart (i.e. automated) contracts, facilitated through a blockchain, can help manage digital rights and allocation of royalties' revenue. This is as peer-to-peer transactions recorded in a blockchain are transparent (i.e. traceable as to who owns and who uses content).

In order to understand the application of blockchain technology in intellectual property more clearly，we use Fig. 1 to show the three-tier structure of the aforementioned IPP platforms. The bottom layer is the blockchain network itself, which is essentially a decentralized ledger. The middle layer is the business logic and the consensus mechanism, which provides IPP services such as account registration, checking, provision and transaction records. The top layer is the application layer, where users interact through the provision of IPP services.

A McKinsey consulting report suggest blockchain technology as having the potential to enable network-based neutrality as trust amongst its participants is computationally implemented through distributed and verified peer-to-peer collaboration[14]. The report highlights ways in which blockchain can, for example, help protect artists' rights and redefine how artists can be remunerated in fairer ways, as a blockchain platform track content usage and ownership in a safe (i.e. ensure data has not been non-tampered with) and transparent (i.e. traceable) way.

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

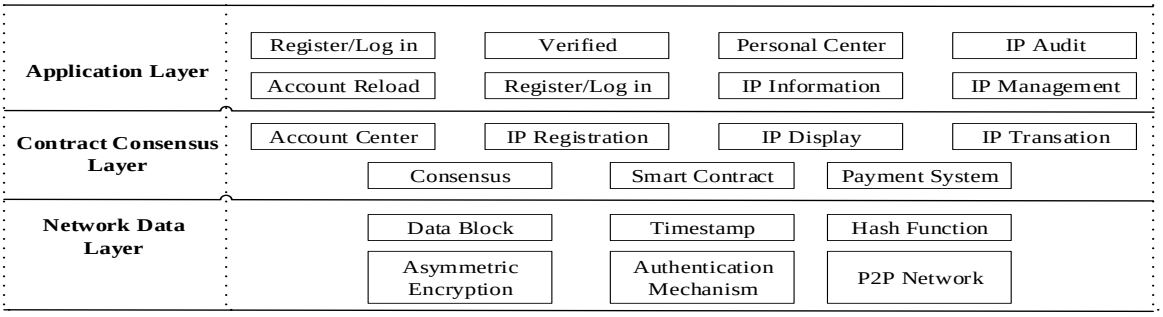

Fig. 1 The Intellectual Property Service System Implementation Framework

3. Methodology

A systematic literature review has been done for this section, with a mapping process focused on highlighting existing studies related to blockchain and IPP. This is illustrated in Fig2.

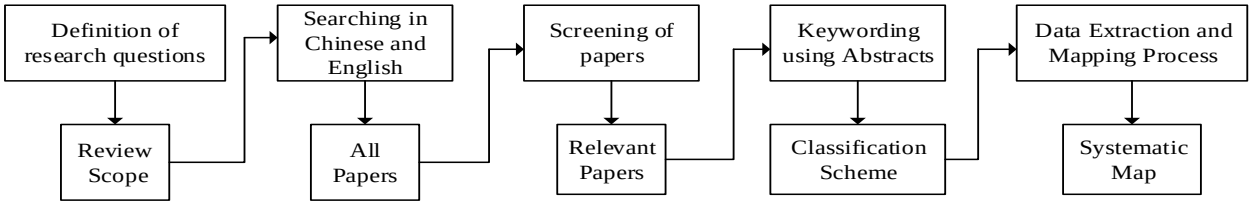

Fig. 2 The Systematic Mapping Process

The first stage of this process was to define the research questions, which has then been followed by searching for the relevant papers. The choice of databases included peer-reviewed publications in conferences, symposiums, and journals within the following online services: (1) IEEE Xplore, (2) Springer, (3) ScienceDirect, (4) CoinDesk, (5) CNKI, and (6) Mondaq. The string terms used for that were: 'intellectual property of blockchain' and 'application of blockchain in intellectual property' both in Chinese and English. Searches have been done in Chinese language due to the indications that China is an active player in blockchain-related investments[15].

As papers resulting from the search were not necessarily related to the research questions, these needed to be assessed for their actual relevance. To screen the relevant papers, a process inspired by authors[16] has been used. We exclude studies that were not relevant to the research topic based on the title firstly. However, in some cases, it was difficult to determine the relevancy of the paper on the heading so the second stage was about assessing abstracts according to our relevance criteria. We used keywords to qualitatively cluster according to the categories regarding each paper contribution. Table 1 below shows the data fields created to help with the qualitative categorization of selected papers. Items ID1 to ID7 are about papers metadata and items.

Table 1 Data Extraction Items

Coding	Data Item	Description
ID1	Title	Paper title
ID2	Authorship	Author(S) names
ID3	Country	Country of the author(s)
ID4	Publisher	Publication venue
ID5	Publication type	Conference, Journal
ID6	Publication target	Academia/Industry

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

ID7	Abstract	Abstract text

72 papers were initially retrieved when the designed search protocol was applied to the selected scientific databases. The reason for the high number (21) of excluded papers was that they were not related to the research topic. For example, excluded papers discussed blockchain issues such as smart contract and its structure, which were not directly relevant to our study. With the remaining 51 papers, we removed duplicates, such as items found to be translations to/from Chinese and English. This reduced the selection to 48 papers. After this, we read the abstracts of the selected papers and removed further 19 papers that targeted smart contracts or illustrating conceptual applications of blockchain to intellectual property. When the paper did not offer clear contributions, these have been moved to the next selection round for more in-depth analysis. This process resulted in the selection of 25 papers, which were deemed suitable for our research.

4. Conclusion

4.1 Publication Year, Source, and Geographic Distribution

Interestingly all selected papers were published after 2015, which does suggest the rather recent nature of blockchain usage for intellectual property. The distribution of publication year is as follows: 1 paper (4%) in 2015, 6 papers (24%) in 2016 and 18 papers (72%) in 2017. A total of 15 (64%) papers have been published in magazines and journals, with 6 (24%) papers in academic news and 3 (12%) papers in conferences. A total of 19 (76%) papers were academic-oriented and 6 (24%) were industry-oriented. However, it is possible that papers published by commercial entities (i.e. non-academic research organizations) would not have been included in the selected scientific databases. This is as many industry papers are found as white papers or news, and so are often not published through peer-reviewed academic processes and structures. A total of 10 (40%) have been published by universities, or companies, in the United States. China and Europe have each 7 (28%) published papers. The geographical distribution of the selected papers suggests the concept of a blockchain as gathering interest for IPP. On October 1st 2017, a search for "blockchain in intellectual property protection" on the global patent engine "Patentcloud" resulted in a number of patent entries: 200 (United States), 69 (World Intellectual Property Organization), 12 (China), and 3 (Europe).

4.2 Intellectual Property Applications and Market Distribution

Oustry [17] pointed rather directly that blockchain technology can be deployed as a registry of intellectual property rights to catalog and store original works for copyright is unregistered in the UK. Gail A. Van Norman & Roï Eisenkot [18] demonstrated how to identify and register intellectual property and identified that copyrights award exclusive rights to works of creative authorship, including works of fiction, nonfiction, music, choreography, and architecture. It has been evidenced that blockchain offers a large number of obvious possibilities for IPP, registration, trade, commerce, certification, collective and evidence of creatorship[19]. Meanwhile some authors[20] suggested that companies file for blockchain patents to protect intellectual property in the U.S. including large technology companies like Amazon.com and blockchain start-ups such as Coinbase. Some writers[21] elaborated on the challenges, advantages, and disadvantages facing the digital copyright protection and mentioned some problems needed to be resolved. Other authers[22] described the blockchain architecture and Zeilinger[23] explored the use of blockchain to create proprietary digital art markets. Sellin[24] stressed XYZ reasons to explore potential opportunities that blockchain can create for businesses. Dale[25] concluded that if people become accustomed to using the blockchain to spend money, they will use it for other digital assets as well. It's believed that blockchain is uniquely suited to manage complex intellectual property rights[26]. Some writers[27] used the blockchain technology and intelligent contract to design a trust DCI control model for digital works, which provides a comprehensive solution for copyright registration, handling, trading and protection of digital works, which also can guarantee the authority of the copyright information while improving security. Zhou, Li, & Guo introduced the status quo of the patent layout of the blockchain technology, pointed out

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

the main application place and the applicant, and concluded that the potential risk of intellectual property in the blockchain area is small.

4.3 Intellectual property in media & music & art & luxury brands & academic credential & film & videos based on blockchain

The concrete applications of blockchain in intellectual property, blockchain ecology circle, wisdom community and social credit system have been explored to find a new path of media integration[28]. A multimedia data copyright protection method has been proposed based on blockchain technology to solve the data loss and tampering problems existing in traditional multimedia digital rights system[29]. Musicians, writers, and other content creators were interested in protecting their intellectual property rights, and many platforms were being designed to create a tangible connection between created and consumed time[30] for these platforms could use the blockchain to see the ownership of a work, including any licenses, sub-licenses, and assignment. For example, Dale reached out to makers of the Kindle, the Kobo, and the Nook to ask if anyone was looking at equipping their devices with blockchain technology. Zeilinger used the platform Monograph as an example which based on the decentralization techniques and distributed database protocols to show the interest of digital artists. Mediachain was using blockchain to create a global rights database for writers, photographers, and musicians who lacked the ability to prove and protect ownership of their works and ideas[31]. P. Li stressed that People's Daily and CCIAPCB jointly organized a blockchain technology to melt media applications cooperation exchange to protect copyright, which is the first attempt of Central Media. Digitally customize or personalize pieces of clothing, fashion and luxury brands also try to use blockchain technology to protect their original design. A public university in Australia showed that blockchain can be used to back up academic credentials, which marked the latest intersection of higher education and blockchain more generally. O'Leary[32] shows that The Ministry of Education and Employment has struck an agreement with blockchain start-up Learning Machine Technologies to build a prototype platform that will allow users to securely store and share their academic documents. Herbaut & Negru[33] promoted and evaluated a model for collaborative blockchain-based video delivery, which can complement existing technologies by supporting a wide range of business cases in intellectual property while significantly reducing costs. A BC[34] is a method to store data that cannot be hanged easily in a distributed or decentralized manner, which can be used to protect intellectual property rights in the microfilm industries in China.

References

[1] Shankar, K. (2012). Self-archiving and collaboration in science 2.0: an exploratory study. In Proceedings of the 2012 iConference (pp. 513–514). New York, NY, USA: ACM. https://doi. org/10. 1145/ 21321 76.2132269.

[2] Wallis, J. C., Rolando, E., & Borgman, C. L. (2013). If we share data, will anyone use them? Data sharing and reuse in the long tail of science and technology. PLoS One; San Francisco, 8(7). http://dx.doi.org.ucd.idm.oclc.org/10.1371/journal.pone.0067332.

[3] Helbig, K., Hausstein, B., & Toepfer, R. (2015). Supporting data citation: experiences and best practices of a DOI allocation agency for social sciences. Journal of Librarianship and Scholarly Communication, 3(2). https://doi.org/10.7710/2162-3309.1220.

[4] Kleine, D. (2015). The value of social theories for global computing. Commun. ACM, 58(9), 31–33. https://doi.org/10.1145/2804246.

[5] R. Lakhani, K., Bo Jeppesen, L., A. Lohse, P., & A. Panetta, J. (2006, October 10). The Value of Openness in Scientific Problem Solving. Harvard Business School Working Paper. Retrieved from http://www.hbs.edu/faculty/Publication%20Files/07-050.pdf.

[6] Liu, W., & Lin, H. (2016). Blockchain technology principle and a shallow analysis of intellectual property services based on blockchain technology. Property Rights Guide, (11), 65–69.

[7] He, D., Carl, H., Rose, L., Guo, J., Xun, Z., Vikram, H., … Verdugo, Y. (2016). Virtual currency and its extension: preliminary thinking. Financial Regulation Research, (04), 46–71.

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

[8] Zhou, J., Li, W., & Guo, G. (2017). Patent pattern analysis of blockchain technology. Telecommunication Network Technology, (03), 37–42.

[9] Ha, A. (2016, August 17). Blockai's new tool combines tweeting and claiming copyright. Post News. Retrieved from https://www.postnewsreport.com/blockais-new-tool-combines-tweeting.

[10] Finlow-Bates, K. (2017, June 4). Teosto and Chainfrog implement a blockchain pilot. Retrieved January 11, 2018, from http://www.chainfrog.com/teosto-chainfrog-implement-blockchain.

[11] Holmes, B. (2016, February 14). Ascribe announces BigChainDB, a scalable blockchain database. Brave New Coin. Retrieved January 11, 2018, from https://bravenewcoin.com/-news/ascribe-announces-bigchaindb-a-scalable-blockchain.

[12] Meng, Q., & Wu, Y. (2017). Technology of network copyright trading in the view of blockchain. Publishing Journal, (06), 25–31.

[13] Song, J. (2017, May 26). "YuanBen" created the first blockchain + copyright model in China to open a new era of original protection. Retrieved from http://www.coinsay.com-/article/coinsay.

[14] McKinsey company. (2016, May). How blockchains could change the world. Retrieved from https://www.mckinsey.com/industries/high-tech/our-insights/how-blockchains-could-change-the-world.

[15] KASTELEIN, R. (2017, April 16). Global blockchain innovation: U.S. lags, Europe and China lead. Retrieved from https://venturebeat.com/2017/04/16/global-blockchain-innovation.

[16] Dybå, T., & Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. Information and Software Technology, 50(9), 833–859.

[17] Oustry, F. (2017, May 20). Blockchain-based solutions for intellectual property management. Praxvalue. Retrieved from http://praxvalue.blogspot.com/2017/05/blockchain-based-solutions.

[18] Gail A. Van Norman, M. D., & Roï Eisenkot, Bs. (2017). Technology transfer: from the research bench to commercialization. JACC: Basic to Translational Science, 2(2), 197–208.

[19] Burstall, R., & Clark, B. (2017, March 23). Blockchain, IP, and the fashion industry. Managing Intellectual Property. Retrieved from http://www.managingip.com/Article/3667444.

[20] Spencer, L., & Belcher, M. (2017, October 12). Defensive patenting strategies for blockchain innovators. ROPES&GRAY.

[21] Wu, J., Gao, L., & Zhu, J. (2016). Digital copyright protection based on Blockchain technology. Radio & Television Information, (07), 60–62.

[22] Liu, W., & Lin, H. (2016). Blockchain technology principle and a shallow analysis of intellectual property services based on blockchain technology. Property Rights Guide, (11), 65–69.

[23] Zeilinger, M. (2016). Digital Art as 'Monetised Graphics': Enforcing intellectual property on the blockchain. Philosophy & Technology, 1–27. https://doi.org/10.1007/s13347-016-0243-1.

[24] Sellin, J. (2017, August 18). Blockchain technology expected to strongly impact the intellectual property industry. Valea. Retrieved from http://www.valea.eu/en/news/2017/blockchain.

[25] Dale, B. (2017, October 9). Indie author group makes noises about blockchain for intellectual property. OBSERVER. Retrieved from http://observer.com/2017/10/blockchain-authors-ebooks/.

[26] H. Vidal. Thomas. (2017, April 6). Vidal explains how blockchain can help manage intellectual property rights - Intellectual Property - United States. Mondaq.

[27] Li, Y., Huang, J., & Wang, R. (2017). DCI control model of digital works based on blockchain. Journal of Computer Applications, (11), 3281–3287.

[28] Li, P. (2017). Research on media fusion path based on blockchain technology. The Press, (15), 90–93.

[29] Li, S., & Yao, Y. (2015). Research on copyright protection method of multimedia data based on Blockchain. Science & Technology Information, (35), 13+15.

[30] Castillo, M. del. (2017, April 7). Music groups band together to build blockchain rights solution. CoinDesk. Retrieved from https://www.coindesk.com/music-groups-band-together-build/.

[31] Rizzo, P. (2016, February 23). Media chain is using blockchain to create a global rights database. CoinDesk. Retrieved from https://www.coindesk.com/mediachain-blockchain/.

[32] O'Leary, R. (2017, October 3). Malta's government is putting academic certificates on a blockchain. CoinDesk. Retrieved from https://www.coindesk.com/maltas-government-putting /.

ISSN: 2414-1895 DOI: 10.6919/ICJE.201908_5(9).0017

[33] Herbaut, N., & Negru, N. (2017). A model for collaborative blockchain-based video delivery relying on advanced network services chains. IEEE Communications Magazine, 55(9), 70–76. https://doi.org/10.1109/MCOM.2017.1700117.

[34] Tsai, W. T., Feng, L., Zhang, H., You, Y., Wang, L., & Zhong, Y. (2017). Intellectual-property blockchain- based protection model for microfilms. In 2017 IEEE Symposium on Service-Oriented System Engineering (SOSE) (pp. 174–178).