ICIC Express Letters
Volume **17**, Number **6**, June **2023**

ICIC International ©2023 ISSN 1881-803X
pp. **625–630**

PROTECTING INTELLECTUAL PROPERTY WITH NON-FUNGIBLE TOKEN IN DECENTRALIZED SOCIAL MEDIA

Andrew Leonardi and Arya Wicaksana*

Department of Informatics
Universitas Multimedia Nusantara
Jl. Scientia Boulevard, Gading Serpong, Tangerang 15810, Indonesia
andrew.leonardi@student.umn.ac.id; *Corresponding author: arya.wicaksana@umn.ac.id

Received July 2022; accepted October 2022

Abstract. *The decentralization of social media eliminates the need for central authorities and brings back privacy, ownership, and dissemination to the users. Massive content produced on social media carries the intellectual property (IP) that needs to be protected. This study proposed using a non-fungible token (NFT) to solve the problem by allowing users to create the post as NFT. A prototype decentralized social media application built with NEAR is used to implement and test the proposed solution. The results show that creating a post as NFT on a decentralized social media application is achievable with an average minting time of 7.73 seconds and minting fees of USD 0.7. A concurrency test was also conducted to observe the behavior of the minting process upon scaling up requests. Low variance suggests the consistency and stability of the proposed solution in terms of time, cost, and scalability. In addition, the proposed solution scored 85.49% for user satisfaction from 31 respondents.*

Keywords: Blockchain, Decentralized social media, Intellectual property, Minting, Non-fungible token

1. **Introduction.** Blockchain allows the development of Web3 and decentralized applications [1-3]. The decentralization of social media is taking place in recent works [4-8] concerning users' data privacy, ownership, and dissemination. The elimination of centralized authorities raises a concern about intellectual property (IP) infringements on social media [9,10] in areas such as trademarks, logos, copyright, and designs [11]. Social media hosts a massive amount of content generated by users. The central authority controls and manages disputes regarding infringements through a valid DMCA (Digital Millennium Copyright Act) complaint submitted via the form to the platforms [12-15]. Decentralized social media brings new challenges to taking and resolving infringement complaints without trusted central intermediaries [16].

Non-fungible token (NFT) is an approach proposed in this study to resolve the challenge of intellectual property infringements in decentralized social media [17,18]. The proposed approach aims to protect intellectual property contents in the decentralized application by posting it as NFT on the platform. Related studies focus mainly on the law aspect of the problems [19] and identifying critical technologies related to it [20]. The arrival of decentralized social media and applications enabled by blockchain and smart contract technologies exacerbate the need for IP protection tailored to the situation. The main contribution of this study is the realization and evaluation of the approach to a prototype decentralized social media application that runs on NEAR. This study allows social media users to generate NFT-based posts instead of regular posts.

DOI: 10.24507/icicel.17.06.625

The rest of this paper is organized as follows. Section 2 describes the research methods. Section 3 explains the results and discussion. Finally, Section 4 concludes this paper with some suggestions for future work.

2. **Methods.** This section discusses the research methodology conducted in this study to address intellectual property (IP) infringements using NFT for decentralized social media applications. A prototype of the application is developed separately from this study. The challenges tackled throughout this section are the design and implementation of the NFT-based user generation content for IP protection on a decentralized social media application and the testing and evaluation of the proposed approach in terms of time and cost. Thus, this study focuses on creating NFT based on users' posts in the application. The objective is to demonstrate the usage of NFT as a solution to protect user-generated content from IP infringements on decentralized social media.

2.1. **Design and implementation.** The system design phase comprises two parts: smart contract and user interface. This study is additional work to the existing prototype decentralized social media application. Figure 1 shows the front-end flowchart, and Figure 2 shows the back-end flowchart of the proposed NFT module for the prototype decentralized social media application.

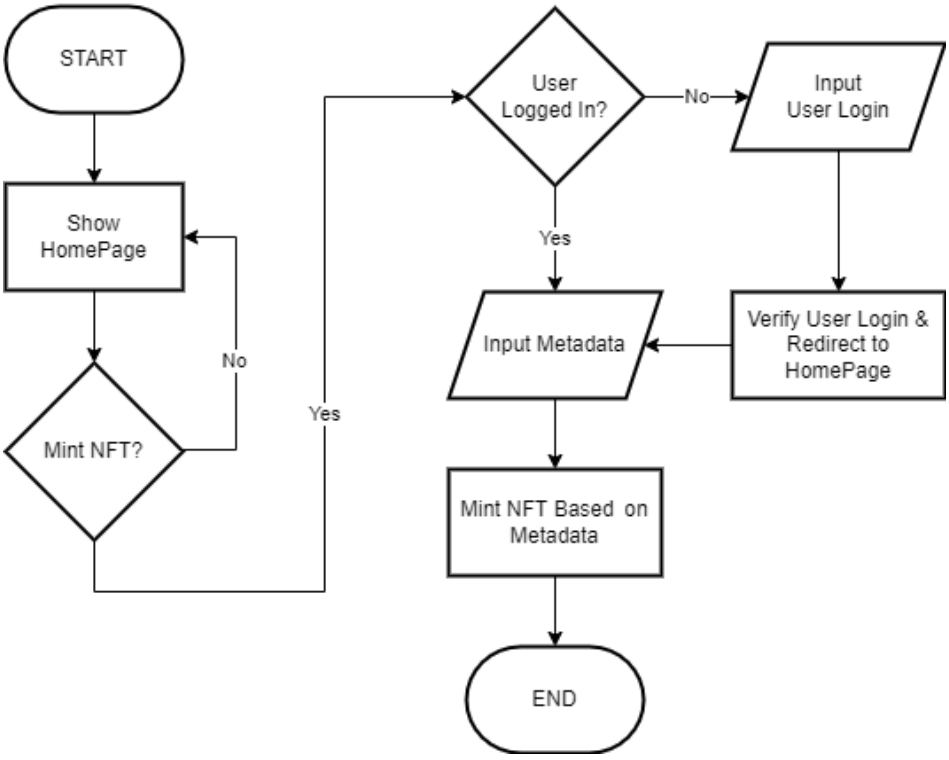

Figure 1. NFT minting front-end

The minting process is manageable for the users to access by connecting their wallet to the application. Users can make an NFT of the post by minting it and settling the minting fees. The minting process takes the post metadata (user-generated content). Minted posts are recorded on the blockchain for IP protection and coverage purposes. This is achieved by checking and comparing the metadata of the NFT to be created with the NFTs that are already created, which is described in Figure 2.

The NFT module receives a request from the users to make the post as an NFT. The metadata required is processed for creating the NFT on the back-end. The created NFT is transferred to the user's wallet. Figure 3 shows the graphical user interface of the minting

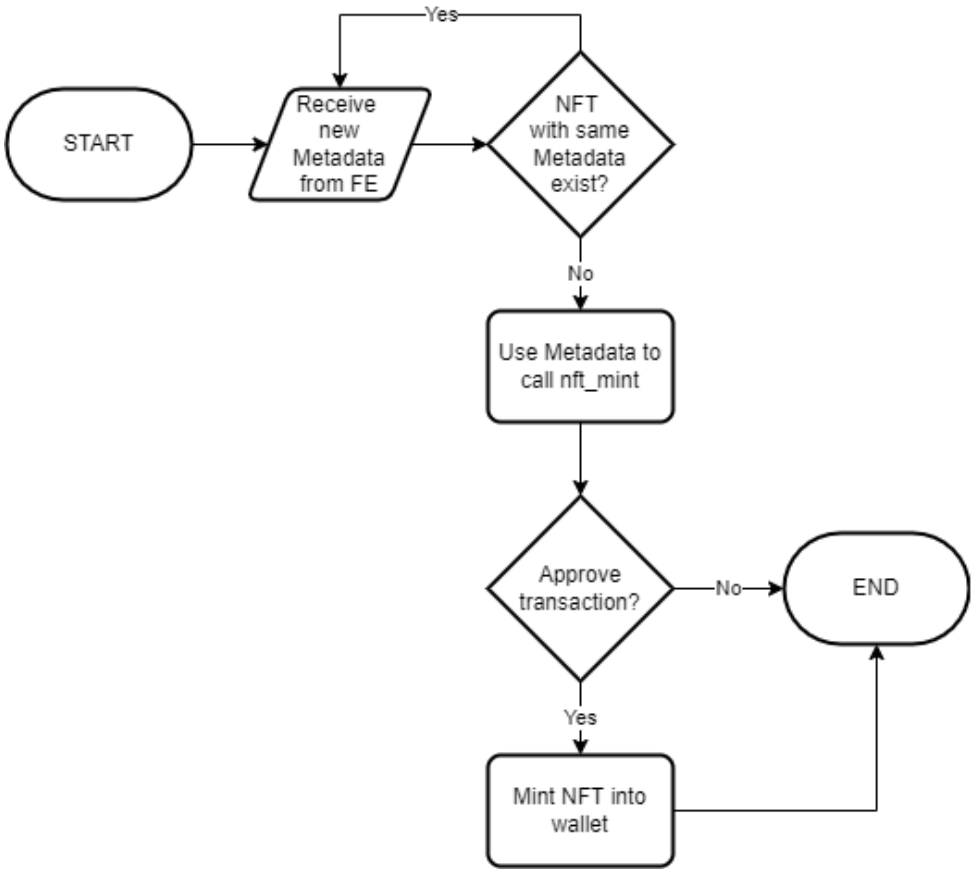

FIGURE 2. NFT minting back-end

page. The minting process utilizes the library provided by NEAR. The parameters for minting an NFT are the followings.

1) TokenId: the identifier of the published NFT. This identifier is generated automatically on the front-end and sent to the smart contract when the minting function is called. The identifier is set to account identifier + "nft-post" + date and time + random number.

2) TokenMetadata: this data is obtained from the input previously given by the user.

3) AccountId: the recipient of the published NFT, which in the case of the NFT minting application is the user.

On the NFT minting page shown in Figure 3, there is a login button at the top that, when clicked, directs the user to the NEAR Testnet wallet login page. After logging in, the user is taken back to the main application page, where the user is given three input fields: message, title, and description. The message refers to the text (message) posted as an NFT. The title refers to the title of the NFT to publish, and the description refers to the description of the NFT. The process continues to the NEAR transaction approval page. This page appears in response to the minting process. Figure 4 shows the transaction approval page for minting the NFT. The minting process costs 1 NEAR for the user to pay. The published NFT can be viewed in the user NEAR Testnet wallet's Collectibles tab.

2.2. **Testing and evaluation.** The tests aim to find the minting time (second) and minting fee (NEAR) for an NFT. The metadata set up for the minting time test is predefined as "Test Fee" for all fields: message, title, and description. The minting fee test uses a variable-length message. The concurrency test examines the effect of concurrent minting requests on the minting time. The user is asked to fill out a survey questionnaire to evaluate the acceptance of this approach.

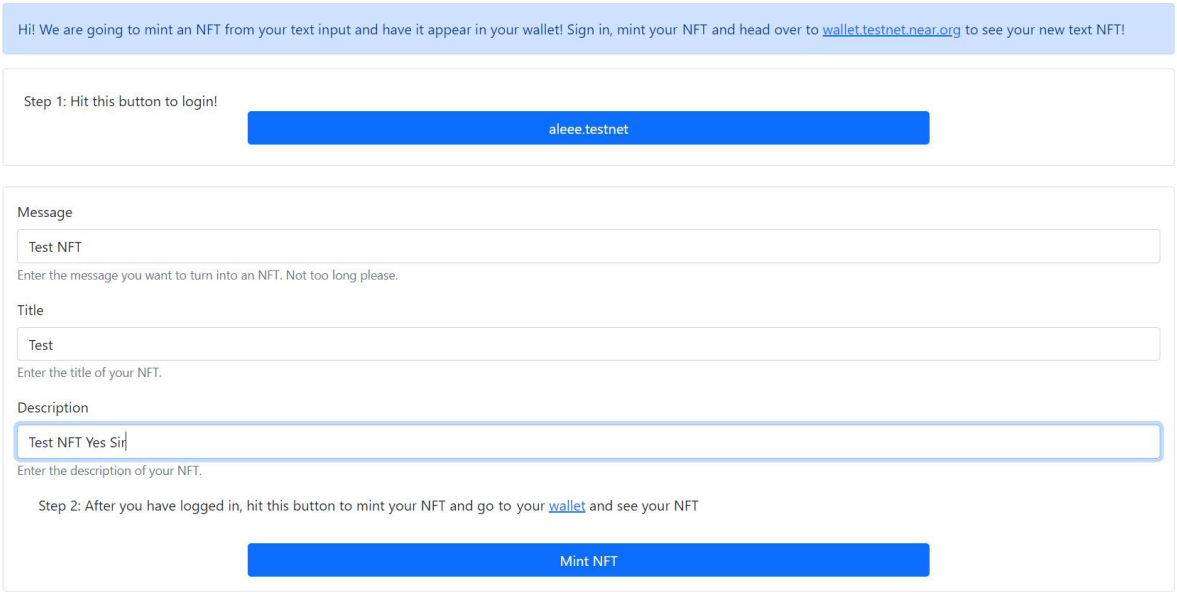

FIGURE 3. NFT minting page

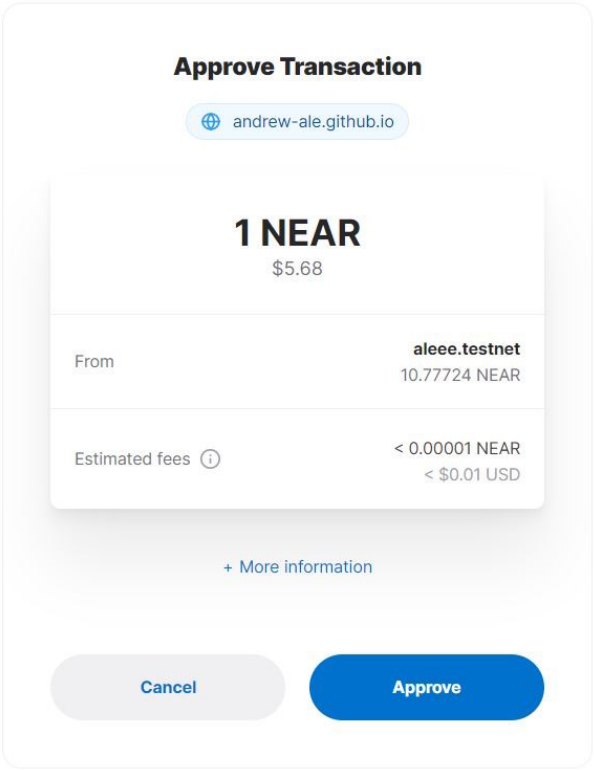

FIGURE 4. NFT transaction approval dialog

3. **Results and Discussion.** The tests to find NFT minting time are shown in Table 1. The total minting time for ten NFTs with the same metadata is 77.28 seconds, with an average of 7.73 seconds per NFT. The variance is 1.935, which indicates the minting time for an NFT is near consistent and stable.

The minting fee test results are shown in Table 2, and the results are also consistent and stable. The variance found for this test is 2.287 E-6. The cost to mint ten NFTs is 0.155 N $\approx$ USD 0.7 (July 20th, 2022). On average, the minting fee for an NFT is USD 0.07. This is true for the ten tests with message content varying in length between 1 and 450 characters.

Table 1. NFT minting time test results

Test No.	Minting time (s)
1	10.64
2	7.09
3	6.73
4	7.08
5	9.97
6	7.43
7	7.36
8	6.83
9	6.76
10	7.39

Table 2. NFT minting fee test results

Number of characters	Minting fee (NEAR)
1	0.01322
50	0.01371
100	0.01421
150	0.01471
200	0.01521
250	0.01571
300	0.01621
350	0.01671
400	0.01721
450	0.01771

Table 3. NFT concurrency test results

Number of users	Average minting time (s)
1	7.48
3	9.48
5	8.18

The concurrency test also shows no significant differences in average minting time for one, three, and five simultaneous minting requests. Table 3 presents the results of the concurrency test. The metadata set for this test is predefined to "Test Message NFT" for all fields. The consistency of the minting time is essential for the decentralized social media application to scale up to serve more users. The variance for this test is 1.03, demonstrating the consistency of the minting process for concurrent user requests.

4. **Conclusions.** This study contributes to realizing NFT-based posts tailored to decentralized social media. This study shows a feasible and acceptable solution for protecting IP in decentralized social media applications. The minting time and fees based on the tests show the consistency critical to this solution's adoption. The concurrency test finds that the NFT-based posts could scale up with existing blockchain technologies to handle more user requests without significantly dropping the performance. The survey indicates a high acceptance rate from users. This study establishes the opportunity for studies on voting and consensus mechanism to resolve infringement disputes collectively.

The shortage of this study is that the NFT-based post is still limited to text only, and multimedia contents such as images, videos, and sounds are not studied. The minting

feature also lacks copy detection and verification components. These shortages allow future studies to expand the work for minting multimedia files and adding copy detection and verification components to the minting process. Implementation and testing of the solution on full-scale decentralized social media would reveal more actual performance and cost findings.

Acknowledgment. The authors would like to thank Universitas Multimedia Nusantara for the support of this research work.

REFERENCES

[1] M. El Khatib, F. Beshwari, M. Beshwari and A. Beshwari, The impact of blockchain on project management, *ICIC Express Letters*, vol.15, no.5, pp.467-474, 2021.
[2] B. B. A. Christyono, M. Widjaja and A. Wicaksana, Go-Ethereum for electronic voting system using clique as proof-of-authority, *Telkomnika (Telecommunication Comput. Electron. Control.)*, vol.19, no.5, 1565, 2021.
[3] L. Mark, V. Ponnusamy, A. Wicaksana, B. B. Christyono and M. Widjaja, A secured online voting system by using blockchain as the medium, in *The Smart Cyber Ecosystem for Sustainable Development*, P. Kumar, V. Jain and V. Ponnusamy (eds.), Wiley, 2021.
[4] DeSo, *DeSo: The Decentralized Social Network*, https://docs.deso.org/about-deso-chain/readme, Accessed on Jul. 14, 2022.
[5] Project Liberty, *Decentralized Social Networking Protocol (DSNP)*, https://unfinished.com/wp-content/uploads/dsnp_whitepaper.pdf, 2020.
[6] P. Zeng, S. Chen and K.-K. R. Choo, An IND-CCA2 secure post-quantum encryption scheme and a secure cloud storage use case, *Human-Centric Comput. Inf. Sci.*, vol.9, no.32, 2019.
[7] T. Paul, A. Famulari and T. Strufe, A survey on decentralized online social networks, *Comput. Networks*, vol.75, pp.437-452, https://tu-dresden.de/ing/informatik/sya/ps/ressourcen/dateien/beschaeftigte/mitarbeiter/folder-2016-01-25-7369698949/crv/paul14survey.pdf?lang=de, 2014.
[8] C. A. Yeung, I. Liccardi, K. Lu, O. Seneviratne and T. Berners-Lee, *Decentralization: The Future of Online Social Networking*, https://www.w3.org/2008/09/msnws/papers/decentralization.pdf, 2009.
[9] H. Bugshan, Intellectual property rights and social media: Copyright in the digital era – Social media and copyrights, in *Handbook of Research on Integrating Social Media into Strategic Marketing*, H. Bugshan (ed.), IGI Global, 2015.
[10] D. Collopy, Social media's impact on intellectual property rights, in *Handbook of Research on Counterfeiting and Illicit Trade*, P. E. Chaudhry (ed.), Edward Elgar Publishing, 2017.
[11] Stephenson Law, *Social Media and Intellectual Property: When Sharing Might Not Be Caring*, https://www.stephenson.law/blog/social-media-and-intellectual-property-when-sharing-might-not-be-caring, Accessed on Jul. 21, 2022.
[12] Instagram, *Reporting Copyright Infringements*, https://help.instagram.com/454951664593304, Accessed on Jul. 21, 2022.
[13] Twitter, *Copyright Policy*, https://help.twitter.com/en/rules-and-policies/copyright-policy, Accessed on Jul. 21, 2022.
[14] YouTube, *Copyright*, https://www.youtube.com/howyoutubeworks/policies/copyright/, Accessed on Jul. 21, 2022.
[15] Facebook, *Intellectual Property*, https://www.facebook.com/help/399224883474207/?helpref=breadcrumb, Accessed on Jul. 21, 2022.
[16] A. Ramos, The metaverse, NFTs and IP rights: To regulate or not to regulate?, *WIPO Magazine*, https://www.wipo.int/wipo_magazine/en/2022/02/article_0002.html, Accessed on Jul. 21, 2022.
[17] G. J. Chinlund and K. S. Gordon, What are the copyright implications of NFTs?, *Reuters*, https://www.reuters.com/legal/transactional/what-are-copyright-implications-nfts-2021-10-29/, Accessed on Jul. 21, 2022.
[18] E. Ferrill, S. Shah and M. Young, Demystifying NFTs and intellectual property: What you need to know, *Reuters*, https://www.reuters.com/legal/legalindustry/demystifying-nfts-intellectual-property-what-you-need-know-2022-05-10/, Accessed on Jul. 21, 2022.
[19] A. A. Dolganin, Non-fungible tokens (NFT) and intellectual property: The triumph of the proprietary approach?, *Digit. Law J.*, vol.2, no.3, 2021.
[20] S. M. H. Bamakan, N. Nezhadsistani, O. Bodaghi and Q. Qu, Patents and intellectual property assets as non-fungible tokens; key technologies and challenges, *Sci. Rep.*, vol.12, no.1, 2022.