ISSN 1816-6075 (Print), 1818-0523 (Online)
Journal of System and Management Sciences
Vol. 14 (2024) No. 10, pp. 17-47
DOI:10.33168/JSMS.2024.1002

Modelling Token-Incentivized Participation Architectures for Equitable and Trustworthy Social Platforms

Victoria De Greatha, Wella, Arya Wicaksana

Faculty of Engineering and Informatics, Universitas Multimedia Nusantara, Indonesia
wella@umn.ac.id

Abstract. This conceptual modelling research investigates infrastructure designs supporting decentralized social media leveraging blockchain verified identities and non-fungible token (NFT) facilitated content transactions. Diagrammatic analysis following the object-oriented methodology depicts economic and software mechanisms allowing participant monetization of original posts through cryptocurrency micropayments and resale royalties. Systematic ownership protections aim to foster trust and transparency deactivated in conventional models exploiting uncompensated user data. While limitations persist in underlying platform maturity, regulatory uncertainty, and mass adoption prerequisites, envisioned participatory architectures offer renewed pathways to reconcile open exchange with personal agency and value.

Keywords: blockchain, decentralized social media, non-fungible token (NFT), object-oriented methodology.

1. Introduction

Social media is one of mobile or network-based platform that is widely used by people to interact with other people to establish relationships or gain connections (Choi, T. M. & Luo, 2019), which in general people share about their personal interests, activities, background, and personal relationship in social media (Song et al, 2019). However, the freedom to communicate and share information on social media often causes several problems, such as the spread of fake news, cyberbullying, spam, etc. (Rasidin et al, 2020). These problems on social media caused by the existence of anonymous identities. Despite not all anonymous identities give a negative impact, but it is difficult to identify the real owner of anonymous identities (Saptiawan, 2018), so some of social media users find it difficult to control their limits on social media so they tend to do behaviors that is harmful to others (Rini & Manalu, 2020). Therefore, many of social media users are moving from centralized social media to decentralized social media because with blockchain technology that is similar to distributed ledger which any data that is already inputted cannot be changed, because if there is someone who tries to change the data, the system will reject the behavior, making it more guarantees the authenticity of the data and is not easy to fake (Noor, 2020). Therefore, it is necessary to build a new decentralized social media platform that uses users' real identity in order to prevent any inappropriate behaviors happened in centralized social media (Guidi, 2021). Decentralized social media, or what is known as Blockchain-based Online Social Media (BOSM). As a decentralized social media, BOSM does not have a center for storing data, instead users are free to control their data and the content that is shared. BOSM also guarantees the authenticity and authenticity of content so that it is difficult for irresponsible individuals to fake it, because problems regarding the spread of fake news and cyberbullying involving the spread of slander and false hate speech still often occur on online social networks (OSN) (DeSo, accessed Jan. 29, 2022). Therefore, based on BOSM, there is a need for a new decentralized social media platform that displays the real identity of users so that it can minimize deviant behavior on social media.

In order to develop a platform, it is also necessary to have a business process so any transactions that occur in the platform can be sustainable in a long term. In contrast to centralized social media which is managed by single proprietary organization (Palanisamy et al, 2020) and its business model involves activities in which any contents that are posted by the users belong to the platform owner (Guidi, 2021), and as a result content creators who own the content are low paid, less engaged, and make less money because they mostly make money through advertising, while the platform owners gain benefits from contents they don't create (DeSo, accessed Jan. 29, 2022), through decentralized social media every users are free to control their monetization on contents they posted, unlike online social network (OSN) which only rewards famous content creators or celebrities (Guidi, 2021). It can be used with tokens because tokens gain value by any transactions conducted by users on digital platforms, making tokens as money and assets that can be invested (Cong et al, 2021). Tokens are divided into two, one of them is Non-Fungible Token (NFT), which is a certified digital asset that uses blockchain as a proof of ownership to store anything that can be converted to digital files, such as images, music, and videos (Kapoor et al, 2022). NFT is suitable to be combined with decentralized social media because the concept of NFT itself is to appreciate works of art, therefore it can be applied for social media users to sort out original and fake contents and respect original content creators, by allowing users to do NFT transactions in a form of social media contents.

This study's main contribution is to create a business process and tokenomics of decentralized social media to reduce harmful behavior on social media and to ensure the decentralized social media will continue operating with income and outcome; and to create system analysis and design of NFT transactions in decentralized social media. This study Object-Oriented Analysis and Design (OOAD) to create analysis and design of business process and system to create a system whose objects and classes are interconnected with each other. The limits of this study are by using OOAD as the method, this study will be focused on using UML as the modelling language and this study will be conducted only in requirement, analysis, and system design so this study can be used for system development for

the future research.

2. Preliminaries

2.1. Previous research.

Following are literature reviews regarding decentralized social media uses blockchain technology:

Table 1. Previous research.

1	Title	:	FakeNewsIndia: A benchmark dataset of fake news incidents in India, collection methodology and impact assessment in social media
	Author(s)	:	Apoorva Dhawan, Malvika Bhalla, Deeksha Arora, Rishabh Kaushal, Ponnurangam Kumaraguru
	Journal	:	Computer Communications, Volume 185, 1 March 2022, Pages 130-141
	Background	:	Online Social Media platforms (OSMs) have become an important source of information. The high speed at which OSM users transmit data makes moderation very difficult. As a result, apart from offering an online network to users, OSM also becomes a carrier for the spread of fake news. Whether they realize it or not, users circulate fake news on OSM, which has a negative impact on individuals' offline activities. To combat fake news, several specialized websites (referred to as fact checkers) have emerged whose main aim is to identify and report fake news incidents. There are well-known fake news datasets; however, not much work has been done on credible fake news datasets in India.
	Methods	:	Therefore, we design an automated data collection pipeline to collect false incidents reported by fact checkers in this work. We collected 4,803 fake news incidents from June 2016 to December 2019 reported by six popular fact-checking websites in India and made this dataset (FakeNewsIndia) available to the research community. We found 5,031 tweets on Twitter and 866 videos on YouTube mentioned in these 4,803 fake news incidents. Next, we evaluate the impact of new fake incidents on two leading OSM platforms, namely Twitter and YouTube. We use popularity metrics based on engagement ratio and like ratio to measure impact and categorize impact into three levels of low, medium and high. Our learning model uses features extracted from text, images, and videos contained in fake news incident articles written by fact-checking websites.
	Result	:	Experiments show that we can predict the impact (popularity) of videos (appearing in fake news incident articles) on YouTube more accurately (with baseline accuracy ranging from 86% to 92%) compared to the impact (popularity) of tweets on Twitter (with baseline accuracy of 37 % to 41%). We need to build smarter models that predict the impact of tweets, appearing in an article on fact-checking incidents on Twitter as future work.
2	Title	:	Usage of social media, student engagement, and creativity: The role of knowledge sharing behavior and cyberbullying
	Author(s)	:	Muhammad Imran Rasheed, Muhammad Jawad Malik, Abdul Hameed Pitafi, Jawad Iqbal, Muhammad Khalid Anser, Mazhar Abbas
	Journal	:	Computers & Education, Volume 159, December 2020
	Background	:	Despite the increasing use of social media, very little is known about its consequences for postgraduate research training students. The purpose of this research is to examine the results of social media use while answering when and how social media use can lead to student creativity and engagement.
	Methods	:	Primary data were collected from 383 research students studying at various universities in eastern China.
	Result	:	Findings revealed that students' social media use was related to their creativity and engagement in postgraduate research training through knowledge sharing behavior. Additionally, cyberbullying was found to play a boundary condition role such that the mediated relationship was weaker for students who faced more cyberbullying. Limitations and future directions, as well as implications for research and practice, are discussed.
3	Title	:	Blockchain technology awareness on social media: Insights from twitter analytics
	Author(s)	:	Emna Mnif, Khaireddine Mouakhar, Anis Jarboui

	Journal	:	The Journal of High Technology Management Research, Volume 32, Issue 2, November 2021, 100416
	Background	:	This study investigates the affective technology acceptance model applied to the case of blockchain through Twitter text mining.
	Methods	:	This analysis focuses on mapping the drivers of blockchain technology acceptance by visualizing the construction of user perceptions through Blockchain hashtags. More than 5000 relevant tweets per day were collected between December 15, 2020, and January 15, 2021. Kruskal-Wallis and Mann-Whitney tests were applied to the frequency of characteristics and emotion measures to validate the research hypotheses.
	Result	:	The results prove that users are more interested in the characteristics of security, shareability, and decentralization. Therefore, the usefulness of blockchain technology is felt more in the information domain, and the ease of use of blockchain is further expressed in smart contracts as a use case. Blockchain's benefits are more widely discussed than its drawbacks among Twitter users. Additionally, positive feelings with strong emotions of trust and joy predominate among users. In short, the results show significant awareness of users towards blockchain technology.
4	Title	:	Conceptualising a social business blockchain: The coexistence of social and economic logics
	Author(s)	:	Anthony Devine, Abdul Jabbar, Jonathan Kimmitt, Chrysostomos Apostolidis
	Journal	:	Technological Forecasting and Social Change, Volume 172, November 2021, 120997
	Background	:	In this paper we explore how blockchain and smart contracts can build trust and act as a catalyst for sustainable social business by supporting the coexistence of the social and economic logic of social enterprises.
	Methods	:	To achieve this, we use Yunus' seven principles of social business to present six emerging questions that challenge how blockchain can improve the sustainability of social enterprises and support the fulfillment of these principles.
	Result	:	Our contribution is a blockchain model of social business, codifying Yunus' principles as a function of smart contracts, offering new insights into how blockchain can be used to promote the coexistence of social and economic logic (i.e. the defining characteristic of social business). Additionally, it shows that the application of this technology gives rise to a new type of trust relationship between stakeholders, social business and blockchain, which can be facilitated by smart contracts.
5	Title	:	Blockchain-based access control management for Decentralized Online Social Networks
	Author(s)	:	Mohsin Ur Rahman, Barbara Guidi, Fabrizio Baiardi
	Journal	:	Journal of Parallel and Distributed Computing, Volume 144, October 2020, Pages 41-54
	Background	:	Online Social Networks (OSNs) currently represent a large communication channel where users spend a lot of time-sharing personal data. Unfortunately, the huge popularity of OSNs is outweighed by their huge privacy concerns. Indeed, several recent scandals have exposed their vulnerabilities. Decentralized Online Social Networks (DOSNs) have been proposed as an alternative solution to current centralized OSNs. DOSN does not have a service provider acting as a central authority and users have more control over their information. Several DOSNs have been proposed over the past few years. However, decentralization of social services requires efficient distributed solutions to protect user privacy.
	Methods	:	Over the past few years, blockchain technology has been applied to Social Networks to address privacy concerns and offer real solutions to privacy problems in decentralized systems. However, in these platforms, blockchain is usually used as storage, and content is public. In this paper, we propose a manageable and auditable access control framework for DOSN using blockchain technology for privacy policy definition. The resource owner uses the subject's public key to define access control policies that can be audited using an Access Control List (ACL), while the private key associated with the subject's Ethereum account is used to decrypt private data after access permissions are validated on the blockchain. We provide an evaluation of our approach by leveraging Ethereum's Rinkeby testnet to deploy smart contracts.
	Result	:	Experimental results clearly show that our proposed ACL-based access control outperforms Attribute-based access control (ABAC) in terms of gas costs. Indeed, a simple ABAC evaluation function requires 280,000 gases, whereas our scheme requires

			61,648 gases to evaluate ACL rules.
6	Title	:	Go-Ethereum for electronic voting system using clique as proof-of- authority
	Author(s)	:	Basilius Bias Astho Christyono, Moeljono Widjaja, Arya Wicaksana
	Journal	:	TELKOMNIKA, Volume 19, no 5, October 2021, Pages 1565-1572
	Background	:	Current advances in information technology have brought about significant changes, including the way elections are held using computer technology known as e-voting. Blockchain underlies the popularity of the digital currency Bitcoin and several other digital currencies, triggering the start of a new era of Internet use, including electronic voting systems (e-voting).
	Methods	:	In this work, we propose designing and implementing an evoting system powered by the Ethereum blockchain. We use real world data from the Indonesian General Election Commission (KPU) with 26 candidates and 15,725 voters from Jelupang sub-district.
	Result	:	Test and evaluation results using three miners on the blockchain show that the system can perform around 23 transactions per second. All 15,725 votes were committed to the blockchain successfully within 12.75 minutes. The total time required to create all blockchain accounts is 13.4 hours.

Research was carried out using OOAD to create an e-voting system based on Ethereum blockchain due to security problems that still frequently occur, so the results of this research are architectural design, functional and non-functional requirements, entity relationship diagram (ERD), then the system is implemented and tested, which results that the system designed has met the needs and objectives (Law et al, 2021). Apart from that, the OOAD method is also used to model and design an Android-based basic food price prediction system to make it easier for the public to predict unstable basic food prices in advance, so the result of this research is a system design in the form of a use case diagram, class diagram, activity diagrams, and sequence diagrams (Mujilahwati & Fauziah, 2018). Apart from that, business process modeling in research uses other methods, namely BPMN for modeling current and proposed business processes, but OOAD is also used for system analysis and design, Consistency Analysis, and Decision Tables for evaluation, where this research starts from the problem that the information provided accessed is less effective for access by the public, so the results of this research are proposals for new business processes, use case diagrams, system architecture, sequence diagrams, class diagrams, interface designs, and evaluation of system design results which state that the system designed has met the needs and needs of the system. purpose (Setiyawan et al, 2018). Smart contracts-based blockchain application system modeling uses agile methods, but the modeling language uses UML which contains class diagrams, state charts and sequence diagrams to solve the problem of rushing blockchain-based software development due to the rise of blockchain among software developers (Marchesi et al, 2018). Then, the OOAD method is used for system analysis and design, as well as Requirement Traceability, and Consistency Analysis for evaluating system design results, where this research departs from the problem that data collection is still done manually so that decision making takes a long time, so the results of this research are proposals for new business processes for the system to be designed, use case diagrams, sequence diagrams, class diagrams, and system evaluation results which state that the designed system has met needs and objectives (Ismubandono et al, 2019).

Based on previous research that has been described, the novelty of this research is that it uses blockchain which is implemented in social media as a topic for which business processes and system designs will be designed. Several things adopted from previous research to be used as a reference in this pre-research are, research methodology which includes analysis of problems and needs in current business processes to create proposed business processes which become a reference in system analysis and design, where the modeling language is used. is UML; and business process modeling using activity diagrams and system analysis and design using use case diagrams, class diagrams, sequence diagrams and interfaces.

2.2. Decentralized social media.

Decentralized social media uses blockchain technology which is also known as Blockchain-based Online Social Media (BOSM) (Guidi & Michienzi, 2021). The concept of BOSM itself is the

decentralization of social data, which allows users to have a complete control of their own data. The main purpose of BOSM is to give rewards to any contents that are considered valuable, which usually uses cryptocurrency. Several BOSM platforms that are already existed including Sapien, Minds, Appics, Hive Blog, and Steemit. The main features of Blockchain-based Online Social Media (BOSM) are stated below (Guidi, 2021).

- Users have the complete control that also includes monetization control over their contents in social media because the concept of Blockchain-based Online Social Media (BOSM) is decentralized, which there is no centralized authority that collects and stores data.
- Users have their control over governance and content censorship since there is no centralized authority that controls users' content, because Blockchain-Based Online Social Media (BOSM) uses decentralized network.
- Blockchain-based Online Social Media (BOSM) uses blockchain technology to ensure content's originality and authenticity so it can't be changed and copied by malicious third parties.
- Blockchain-based Online Social Media (BOSM) offers rewards using like, share, etc. to evaluate contents that are uploaded in BOSM.
- All Blockchain-based Online Social Media (BOSM) platforms are created as flexible as possible and easily accessible by anyone that supports any access and blockchain platform. Interoperability sets the standard for governance and comparison with applications and smart contracts.

2.3. Tokenomics.

Tokenomics are an economy that implements the demand and supply of crypto assets. The term of "tokenomics" comes from a combination of two words, which are "token" and "economics". The concept of tokenomics is the implementation of incentive system by determining the value of tokens used, which in this case, to get the value of a token, there needs to be an incentive to use the token which later the token will be a demand that determines the token's value (Au & Power, 2018). Each type of value can be managed as a digital asset. The token itself can be seen as privately issued currencies and can be used to exchange value in the ecosystem, as for the example the use of Bitcoin (Freni et al, 2022).

2.4. Non-Fungible Token (NFT).

Non-Fungible Token (NFT) is an asset certification that signifies the originality in the blockchain in digital or physical form. Non-Fungible Token (NFT) comes from the term of non-fungible which means that one token cannot be exchanged with another equivalent token because each NFT is unique (Aletha, 2021).

2.5. Object-Oriented Analysis and Design (OOAD).

Object-Oriented Analysis and Design (OOAD) is an object-oriented method that is used to analyze and design a system. The main concept of OOAD is Object-Oriented Analysis (OOA) and Object-Oriented Design (OOD), where OOA is focused on analyzing requirements from objects and classes perspectives, meanwhile OOD is focused on designing system architecture that refers to system's objects and subsystems (Setiawan et al, 2019).

2.6. Unified Modelling Language (UML).

Unified Modelling Language (UML) is a standard language that is used for writing software blueprints (Booch et al, 1999). UML can be used to understand requirements, analyze, and design system and object-oriented architecture. Business process modelling also can be used to understand system requirements using UML (Sari, 2018). Types of UML diagrams are stated below (Sari, 2018), (Dennis et al, 2015).

- Class Diagram: Class diagram is a collection of classes that describes the relationship between

classes in a system.

- Use Case Diagram: Use case diagram is a collection of actors and use cases that interact one another that describes the relationship between use cases, actors, and system.
- Sequence Diagram: Sequence diagram is a diagram that describes the interaction between objects and their messages that are sent between objects.
- Activity Diagram: Activity diagram is a diagram that models activity flows and business processes, where activity diagram has a similarity with flowchart because both of them describes workflow about one activity to another.

2.7. Related Works.

There are some previous researches that are used for this pre-research as references. The first study was conducted using OOAD to create an e-voting system based on Ethereum blockchain due to security problems that often occur in regular e-voting systems, by modelling architecture design, functional and non-functional requirements, entity relationship diagram (ERD) (Law et al, 2021). The following study also used OOAD to create and model an Android based groceries price prediction system that aims to facilitate people to predict unstable groceries price, which the result of the study are system designs such as use case diagram, class diagram, activity diagram, and sequence diagram (Mujilahwati & Fauziah, 2018). Another following study used BPMN to model current and proposed business process and uses OOAD to analyze and design a system for Dinas Tenaga Kerja (Disnaker) due to the inaccessibility problem which any information are difficult to be accessed, with the result of this study are all the proposed business process and system design has met the needs and objectives (Setiyawan et al, 2018). The next study used agile method and UML as the modelling language to model a blockchain application system based on smart contract, such as class diagram, state charts, and sequence diagram, to solve the problem that happened because of developing a blockchain-based software in a hurry which results in uncontrolled software operation (Marchesi et al, 2018). Another following study used OOAD to analyze and system design, where this study was conducted based on the problem that data collections still conducted manually, with the result of this study are newest business process, use case diagram, sequence diagram, class diagram, which all the results were tested, and the designed system has met the needs and objectives (Ismubandono et al, 2019). Based on the related work, it is determined that some things that were adopted to this pre-research as a reference are the method to analyze requirements and design business processes and system using UML, which are activity diagram, use case diagram, sequence diagram, and user interface.

3. Methods

The research method that is used for this pre-research to model business process and system design is Object-Oriented Analysis and Design (OOAD) using Unified Modeling Language (UML) as a technique to for object-oriented analysis and design. The purpose of using this method is because OOAD allows to model complex systems into simpler and easy-to-manage systems, making it easier to understand because it is object-oriented. UML also has diagrams that are suitable to model system development from analysis until implementations (Dennis et al, 2015), which in this pre-research will be used to model business process or workflow, analysis, and system design. The object that is used for this pre-research is centralized social media, which has a centralized server to store users' data and information. Centralized social media's business model is to give free services for users to use, but all the data and contents uploaded by users belong to platform's owner that can be used to gain profits. Therefore, Figure 1 is the pre-research methodology that is adapted from three research (Dennis et al, 2015), (Ismubandono et al, 2019), (Sunarwoto & Said, 2018).

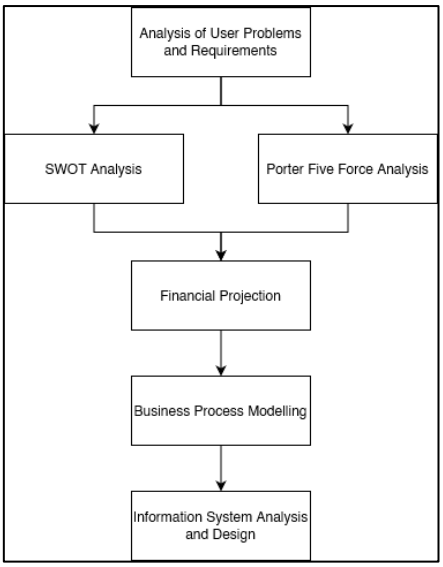

Fig. 1: Flowchart of Pre-research Methodology.

3.1. Analysis of User Problems and Requirements.

This step will be focused on modelling the current business process from the centralized social media that is mainly used by the community, then conducting a problem analysis to determine the problems that occur in centralized social media. From that will result the proposed solution or product's features that will solve the problem by determining functional and non-functional requirements.

3.2. SWOT Analysis.

The goal of this step is to create strategies for the business process by evaluating strengths, weaknesses, opportunities, and threats.

3.3. Porter's Five Forces Analysis.

The goal of this step is to create business strategies to determine five forces which are Threat of New Entrants to the Industry, Bargaining Power of Buyers, Bargaining Power Suppliers, Threats of Substitute Products or Services, dan Competitive Rivalry.

3.4. Financial Projection.

This step will be focused on calculating budget estimation for the proposed business project using Return of Investment (ROI) and Break-Even Point (BEP). ROI aims to evaluate financial statement to determine the profit, meanwhile BEP aims to determine how many products or services sold to cover production fees.

3.5. Business Process Modelling.

This step will be focused on modelling business process based on problems and business requirements that are determined in the previous step, using business model canvas to model a business and activity diagram to model a business' workflow so it will differentiate between centralized and decentralized business processes.

3.6. Information System Analysis and Design.

This step will be focused on analyzing and designing information system based on user problem and requirement analysis using UML such as use case diagram, class diagram, sequence diagram, and user interface.

The pre-research method used to model business processes and systems is Object-Oriented Analysis and Design (OOAD) using Unified Modeling Language (UML) modeling as a technique or method used for object-oriented analysis and design. Table 2 is a comparison between OOAD and other

methods, namely Structured Analysis and Design (SSAD).

Table 2. Comparison between SSAD and OOAD.

SSAD	OOAD
Data-driven	Object based
System analysis and design is carried out sequentially and structured, arranged in process steps in the form of a program	System analysis and design is object-oriented, where all existing data and functions are collected in various classes or objects
Using Data Flow Diagrams (DFD) and Entity Relationship Diagrams (ERD)	Using Unified Modeling Language (UML)
It is difficult to communicate to users because of the lack of tools that can be used, making it more difficult to use in system design and development	Easy to communicate between users and developers, making it easier to use in system design and development

The reason this pre-research uses OOAD as a pre-research method is because OOAD can model complex systems to be simpler and easier to manage, making it easier to understand because it is object oriented, and UML has diagrams that are suitable for modeling system development from analysis to implementation (Dennis et al, 2015). Using OOAD is also easier because this pre-research is a starting point for further research that will be carried out by developers, so an easy method is needed for system development that can be communicated to developers for further research. This pre-research can be used to model business workflow, analysis, and system design, where the research method used in this pre-research is a method adapted from research (Sunarwoto & Said, 2018), (Setiyawan et al, 2018), (Ismubandono et al, 2019).

4. Result and Analysis

4.1. Analysis of User Problems and Requirements.

Social media has a lot of different forms and varieties of creating and uploading contents and establishing relationship with other people (Dennis et al, 2015), for example Instagram which is a social media for uploading contents in a form of photos and videos whose workflow is created in Figure 2, (Law et al, 2021), WhatsApp which is a social media for instant messaging whose workflow is created in Figure 3 (Mujilahwati & Fauziah, 2018), and YouTube which is a social media in a form of video watching site whose workflow is created in Figure 4 (Setiyawan et al, 2018).

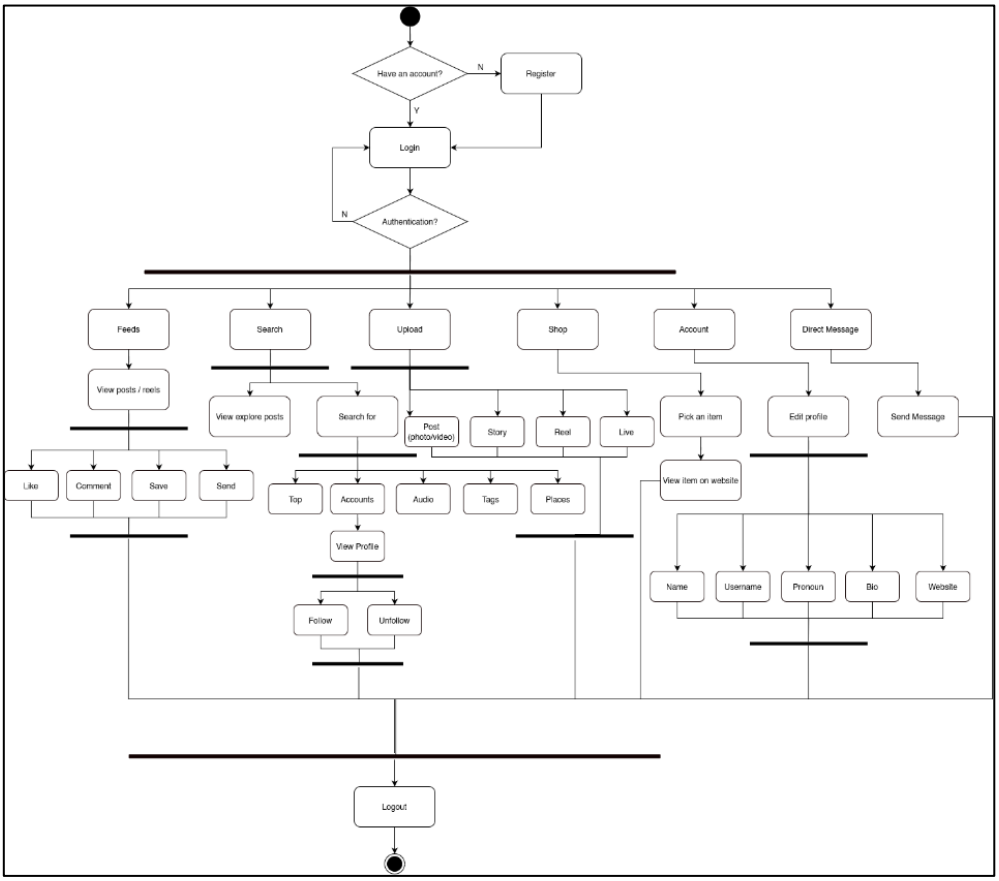

Fig. 2: Instagram Workflow.

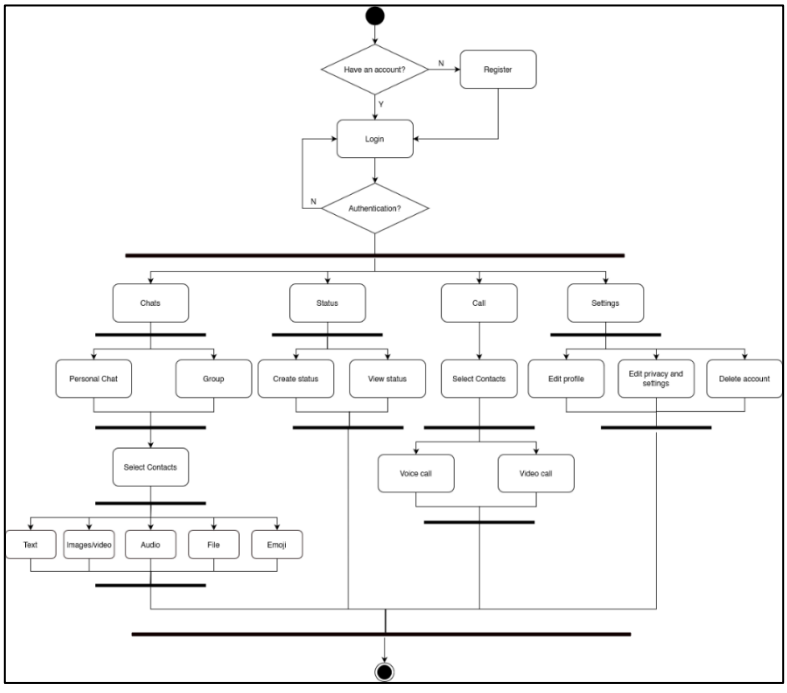

Fig. 3: WhatsApp Workflow.

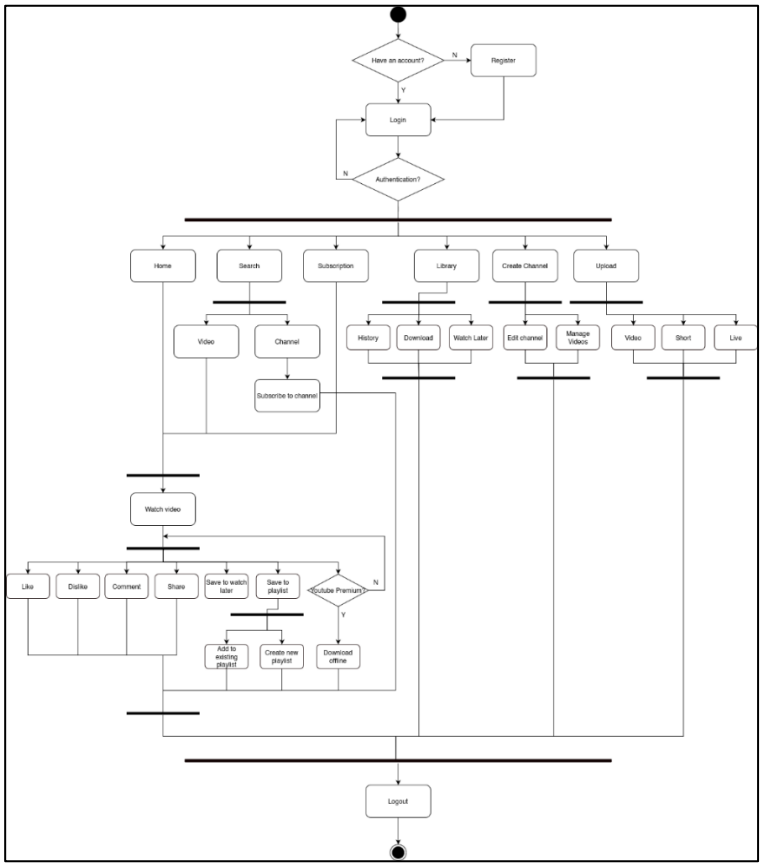

Fig. 4: YouTube Workflow.

In general, social media that is used by users are free, where users are free to use any features without being charged. With this free services, social media uses two business models to earn revenue, such as freemium and advertising. Examples of social medias that use advertising business model are Instagram and Facebook, which its business process is created on Figure 5, and an example of social media that uses freemium business model as well as advertising is YouTube, which its business process is created on Figure 6 and Figure 7.

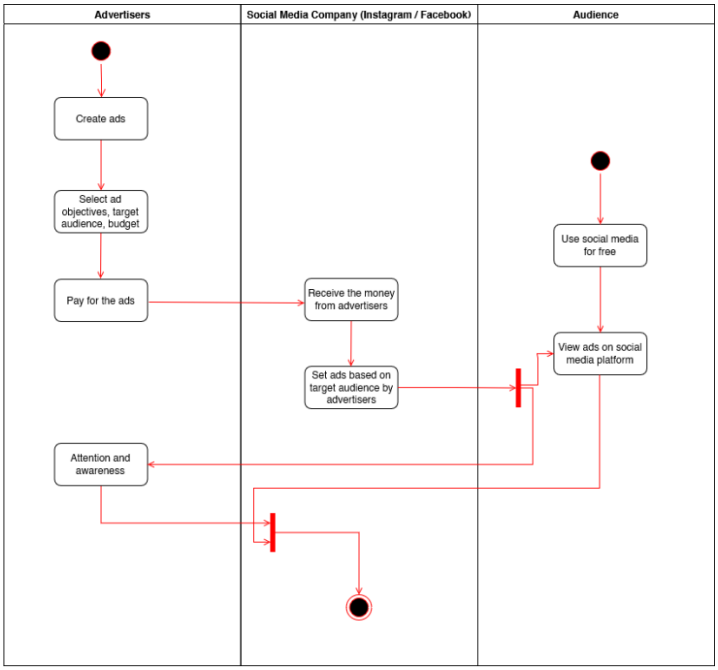

Fig. 5: Activity Diagram of Instagram and Facebook's Business Process.

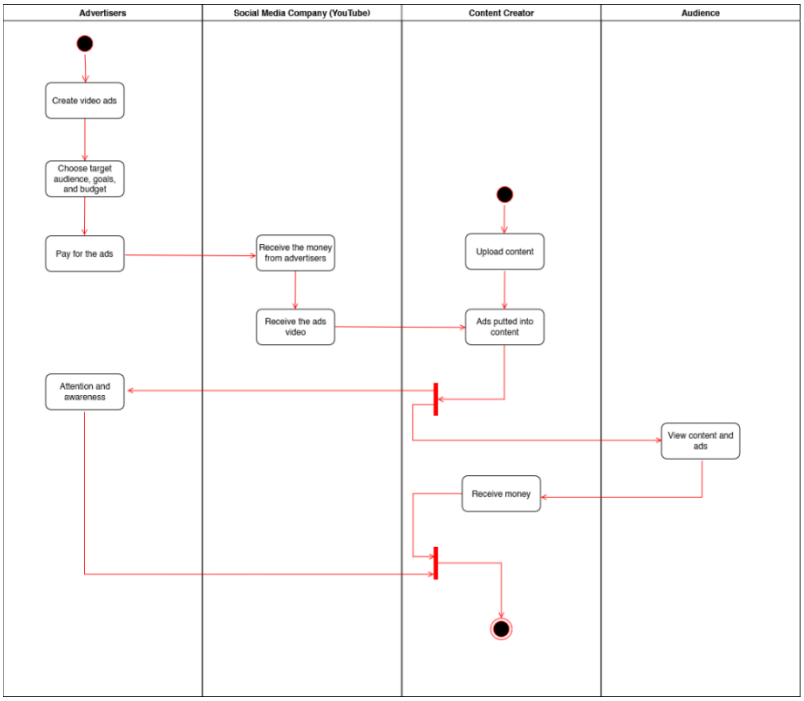

Fig. 6: Activity Diagram of YouTube's Business Process.

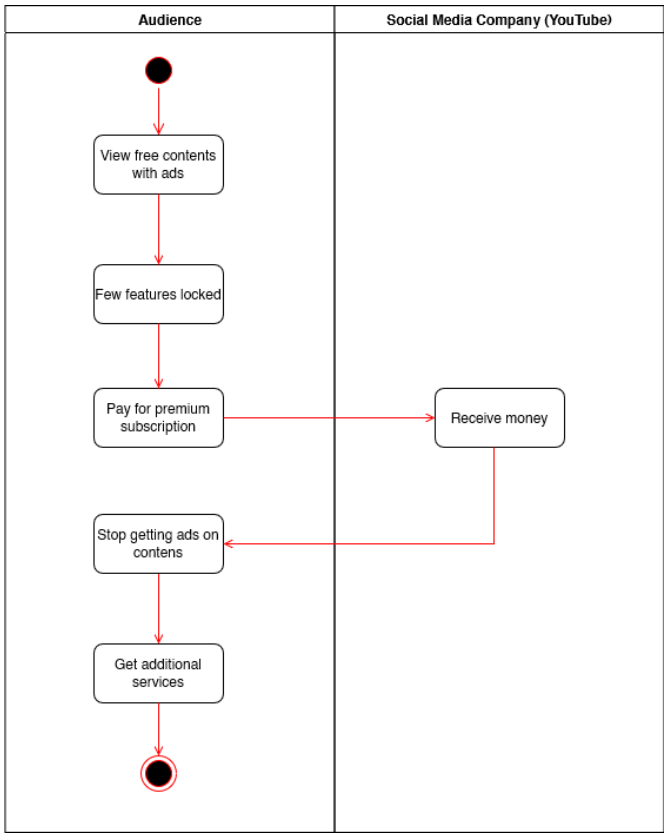

Fig. 7: Activity Diagram of YouTube Premium's Business Process.

Some of users are able to earn money through their contents they posted on social media, for example YouTube. But YouTube itself also has regulations about who can monetize and what content they can monetize (Hua et al, 2022). Moreover, centralized social media still has problems with data authenticity that allows users to spread contents that might not be real, so there are a lot of fake news and fake accounts on social media. This is caused by centralized social media workflow where users

are free to upload any contents they want without any verifications of their identity or content's authenticity.

Therefore, blockchain technology is able to solve this problem, by adopting some of blockchain features to decentralized social media that will be designed using NFT. The solutions for this problem are explained as functional and non-functional requirement on Table 3 and Table 4.

Table 3. Decentralized Social Media Functional Requirements.

Features	Requirements
Register	1. New users need to create account to use the decentralized social media. 2. New users need to input ID, name, e-mail, and password. 3. ID and e-mail must be unique. 4. Password must comply the specified policy
Login	Users are able to login to their account by inputting their ID or e-mail and password
Create Profile	1. Users are able to create profile to store their uploaded NFTs and interact with other contents. 2. Users need to input their name and profile picture, while bio, date of birth, and link are optional. 3. Users can update their profile anytime
Minting NFT	1. All users are able to create their own NFTs in a form of social media contents. 2. Contents can be created in a form of texts, photos, videos, music, or audio. 3. NFT creators are able to set their own royalty percentage if other users resell their NFTs by sharing the content from the original creator and other users are able to like and comment the NFT. 4. Each content that are uploaded will be verified so they won't contain hate speech, fake news, spams, and inappropriate things.
Feeds	1. Users are able to see contents on their feeds. 2. Users are able to give feedback through like and comments. 3. Users are able to buy contents and reshare them. 4. Users who reshare the content from original creator are able to receive token through like and comment from reshared content. 5. Users can report any NFT contents that are inappropriate or violate the regulations to be followed up.

Table 4. Decentralized Social Media Non-Functional Requirements.

Features	Requirements
Operational	System is only able to be accessed through internet network
Security	1. Users are only able to login with correct ID and password. 2. Password can be created with lowercase, uppercase, numbers, and symbols. 3. E-mail verification is conducted to create new account. 4. E-mail notifications are informed when there is new device login detection.

4.2. Information System Analysis and Design.

Table 5 is SWOT Matrix, that combines every analysis of strengths, weaknesses, opportunities, and threats.

Table 5. Decentralized Social Media SWOT Analysis.

	Strengths	Weaknesses
	1. Royalties to users whose contents are reshared or resold by another users. 2. Identity and content verification process to	1. Bubble phenomenon caused by NFT trend rapidly allowing users to continuously mint NFT without further research

	guarantee its authenticity and uniqueness. 3. Users has their own control at their contents. 4. Penalty for users who uploaded contents that violate the regulations.	which causes NFT to be no value. 2. The account must use the original identity and the user must pay to be able to upload the content on social media.
Opportunities 1. Social media as a platform to use on daily basis, NFT trend that keeps increasing, and users are allowed to monetize every content through NFT selling and royalties system that haven't available yet in centralized social media. 2. A lot of fake news and violations happened in centralized social media because of fake identities. 3. Contents uploaded by users in centralized social media belong to platform's owner and users don't have authority over the content.	**S-O Strategy/Analysis** 1. Decentralized social media that gives chance to every user to monetize contents they uploaded in social media. 2. Decentralized social media that is free from fake identities and fake news, also a report features to report any NFT contents that violates the regulations so it will be a safe place from inappropriate. 3. Every content uploaded belong to related content creators.	**W-O Strategy/Analysis** 1. Ensures that the content uploaded by users on social media has value so that users have full rights to monetize and attract other users to support the content by using the rapidly growing market and trends of NFT. 2. A guaranteed system or a money back deposit if you don't buy content after a certain period of time.
Threats 1. Inflations caused by too much NFT minted. 2. Similar platform will be created in the future which will lead to rivalry.	**S-T Strategy/Analysis** 1. Royalty set by users based on demand and stock available to maintain market price. 2. New innovations on social media by using contents from social media as an NFT which all users have the authority over the contents.	**W-T Strategy/Analysis** 1. Users are able to burn their own NFT to control market price. 2. Contents uploaded should have a value to attract other people to use the platform

4.3. Information System Analysis and Design.

There are 5 points that determines forces in competitive strategies and market attractiveness:

- Threat of New Entrants to the Industry: High because there are already so many NFT platforms, and several centralized social medias are trying to expand their platform to adopt NFT in the future.
- Bargaining Power of Buyers: High, because the ability to monetize and resell contents in social media, also NFT trend that keeps increasing will attract more buyers.
- Bargaining Power of Suppliers: Low because the platform doesn't need any fungible supplies to mint NFT.
- Threats of Substitute Products or Services: Low because decentralized social media using NFT can be used as another option to do NFT transactions.
- Competitive Rivalry: High, because there are already a lot of blockchain based social media that also gives reward, but this decentralized social media platform will adopt NFT as the feature that will compete well with other blockchain platforms.

4.4. Information System Analysis and Design.

This platform will get a revenue from minting fee that will be charged every time users try to mint their own content. Based on benchmarking on several NFT marketplaces, the percentage of the minting fee will be 2,5% (Ismubandono et al, 2019). There will be variety of prices set by every user, but the estimation of price every NFT based on benchmark on one of NFT marketplace is $1950 or Rp

28.136.964 per unit with estimation of 10.000 buyers (White et al, 2022). Therefore, the estimated revenue for one year is stated below (1).

$$Revenue\ 1st\ year\ (est) = (28.136.964 \times 10.000) \times 2.5\% = \ 7.034.241.000 \quad (1)$$

Break-even point (BEP) is calculated based fixed cost and variable cost. The estimated fixed cost is Rp 3.700.000.000 and the estimated of variable cost is Rp 100.000.000. Therefore, the estimated BEP is stated below (2).

$$BEP = \frac{3.700.000.000}{\frac{28.136.964.000 - 100.000.000}{281.36.964.000}} = 3.713.196.864 \quad (2)$$

The calculation of return of investment (ROI) is stated below (3).

$$ROI = \frac{7.034.241.000 - 3.700.000.000}{3.700.000.000} \times 100\% = 0.9\% \quad (3)$$

Based on the ROI calculations, this platform will get a 0,9% return on the first year.

4.5. Information System Analysis and Design.

Based on a survey given to 203 respondents who have used social media, it was found that the social media they currently use is filled with pornographic content, hoaxes, cyberbullying, spam, and so on. As many as 49.3% of respondents had received rude comments on their social media. Apart from that, the survey also found a high level of user interest in paid social media, where uploaded content can provide ad sense for each user and is equipped with token and crypto asset transactions. Apart from input from 203 respondents who have used social media and literature studies, the development of this system design also consulted with expertise in the blockchain field who are involved in the world of tokenomics and are interested in decentralized social media. Figure 8 is the Business Model Canvas (BMC) of this decentralized social media platform.

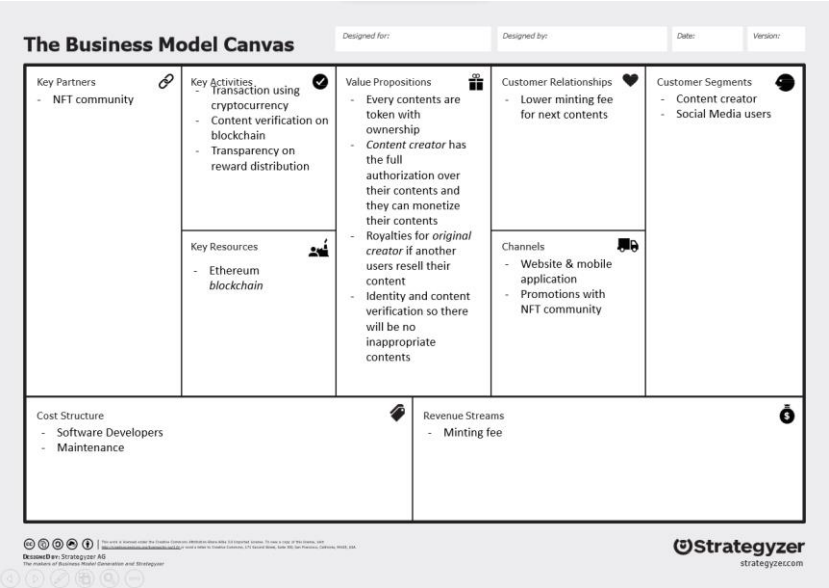

Fig. 8: Decentralized Social Media Business Model Canvas.

Therefore, there are several business processes created for this platform using activity diagram. Figure 9 is the activity diagram that describes business process to register, login, and create a profile to store users' minted NFT. When compared to social media flows in general, when registering they do

not ask about ownership of Ethereum or other e-wallets. The data entered is only name and email, where users can also register via their email. The authenticity of the user is also not the basis for creating an account. Users can have more than one account and use pseudonyms.

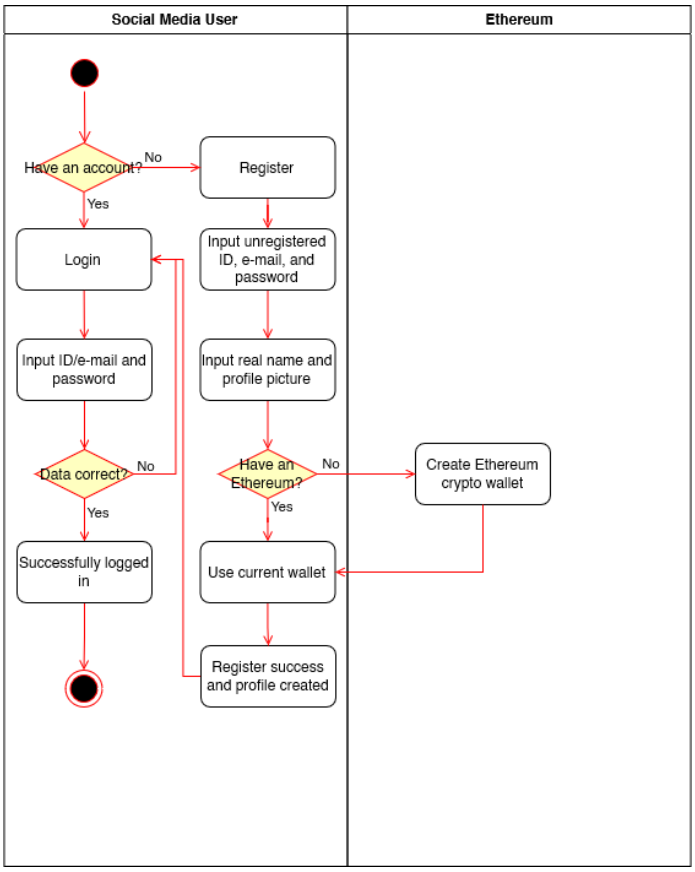

Fig. 9: Activity Diagram of Register, Login, and Create Profile.

Figure 10 is the activity diagram that describes business process to mint NFT or to create contents in social media, in a form of text, photos, videos, and music/audio. By minting new NFTs, users need to pay for the minting fee. Users need to set their price and royalty for every content they will post. The blockchain technology will verify the contents before publishing them to public, by notifying the entire blockchain after the contents are recorded to the blockchain ledger. The system will publish the content to social media if the content is verified original and will be recorded permanently in decentralized ledger so the user will have the full control over the content and cannot be changed or deleted. The original creator of the content will obtain the NFT ownership in a form of unique identifier stated on every content they post. However, if the user and the uploaded content are fake, the content will not appear on social media and each user will get information that the content is fake. For content creators who use popular social media, currently there are no set royalty rates. However, on this social media, users set royalty rates as benefits received by users directly from the content they create. This is also used so that users can be responsible for the content they create. The content they create does not contain hoaxes, spam, and so on. If users are found to be creating hoaxes, spam, etc., they will be recorded on the decentralized ledger.

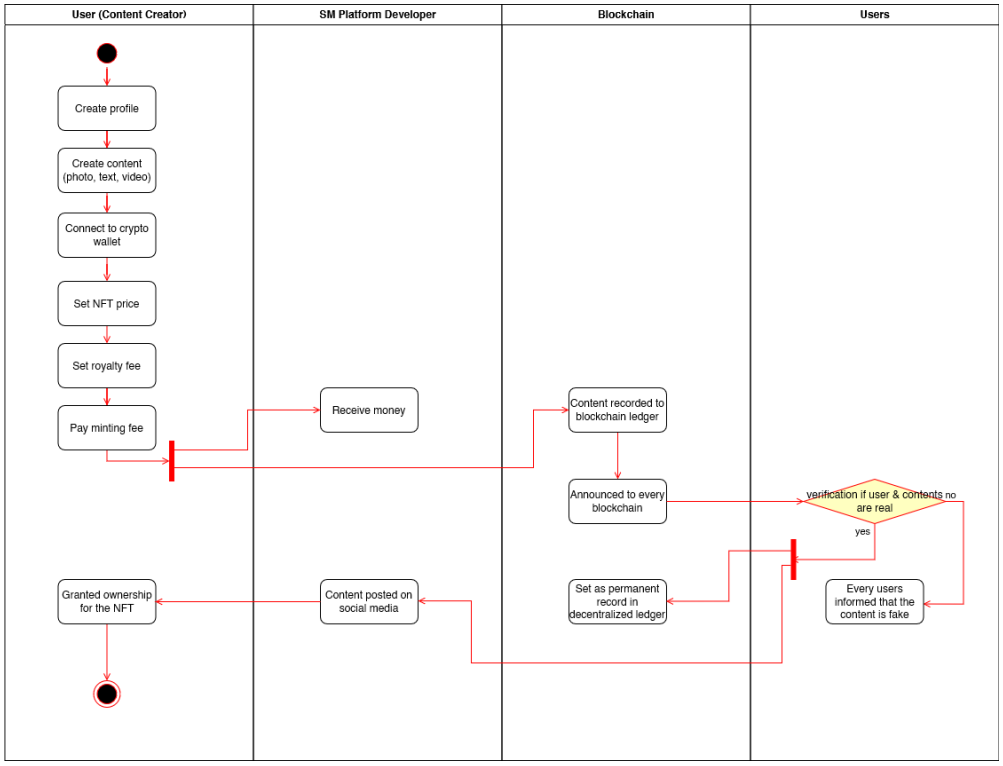

Fig. 10: Activity Diagram of NFT Minting.

Figure 11 is the activity diagram that describes business process for all transactions and interactions on decentralized social media, including like, comment, and share feature. Other users can purchase NFT in a form of social media contents from content creators which is related to the share feature. When the transaction is successful the user will get a token that is unique, and the user can choose to keep the token for personal or collection or resell it by sharing it with other users. If other users buy NFT from a reseller who has purchased NFT from the original content creator, then the reseller user will get money and the original content creator will get royalties from the resale of the NFT. Users can also report other users' NFT content if they feel that the NFT content violates laws and norms and is offensive to others without the original facts. When the platform receives the report and it is proven true, the platform will give some penalties to the content creator. On conventional social media, users can only report content that is deemed not appropriate, but the truth of this cannot be confirmed. Content reporting can be done at will without any clear reason. This can be used if there is disagreement with another user. However, with BOSM this is validated by the DSM Platform and a monetary penalty is given to the user. This is to minimize inappropriate content on social media. Users can also make money by doing activities on this social media.

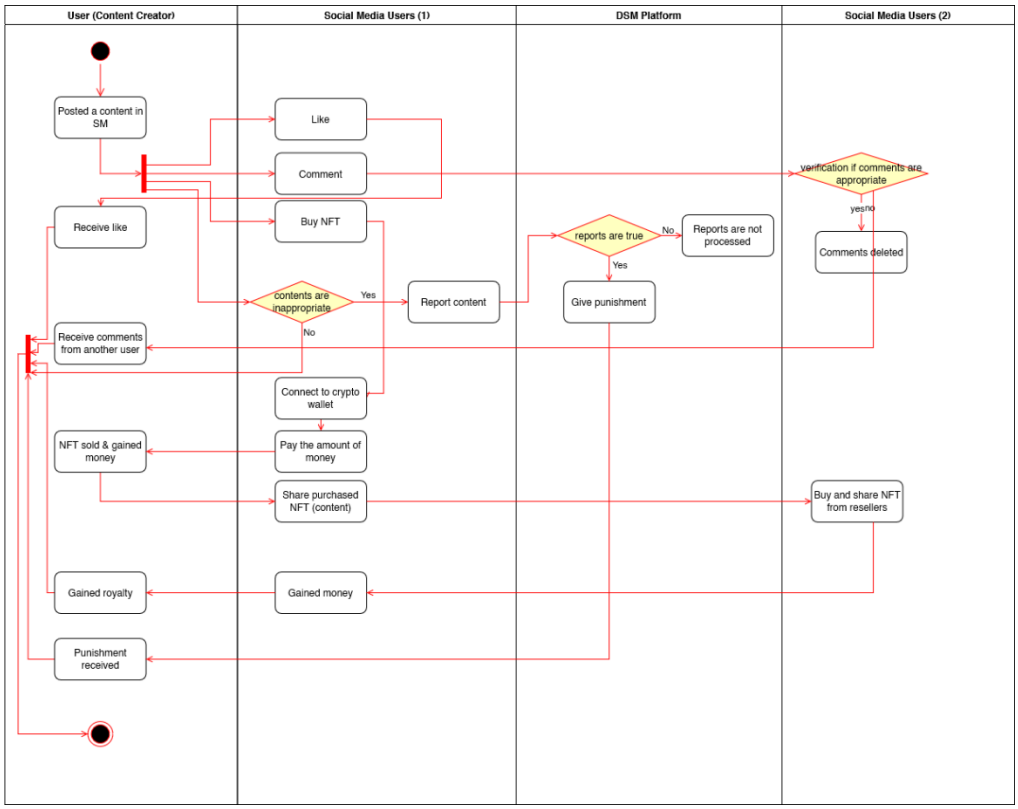

Fig. 11: Activity Diagram of NFT Transaction.

Figure 12 is the activity diagram that describes business process to burn NFT. By burning the NFT, tokens cannot be traded on social media anymore and content will be deleted from content creator profiles.

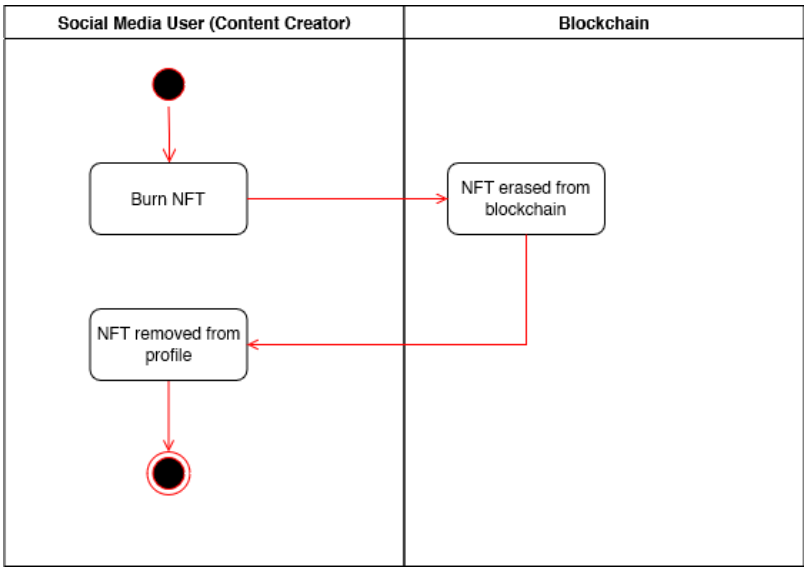

Fig. 12: Activity Diagram of NFT Burning.

Figure 13 is a class diagram for this decentralized social media platform. There are 8 classes that interconnected as the design of proposed decentralized social media.

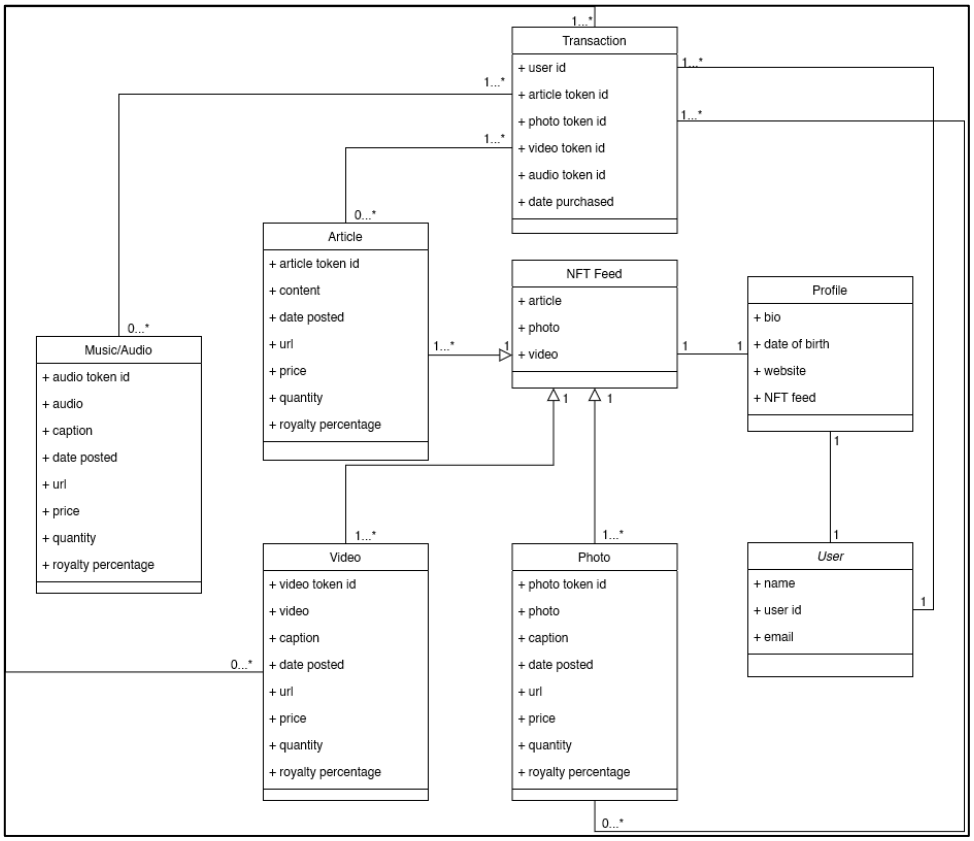

Fig. 13: Class Diagram of Decentralized Social Media.

Figure 14 is a use case to identify actors who are involved in certain events. Types of users are divided into three types, which is content creator, authority, and non-content creator.

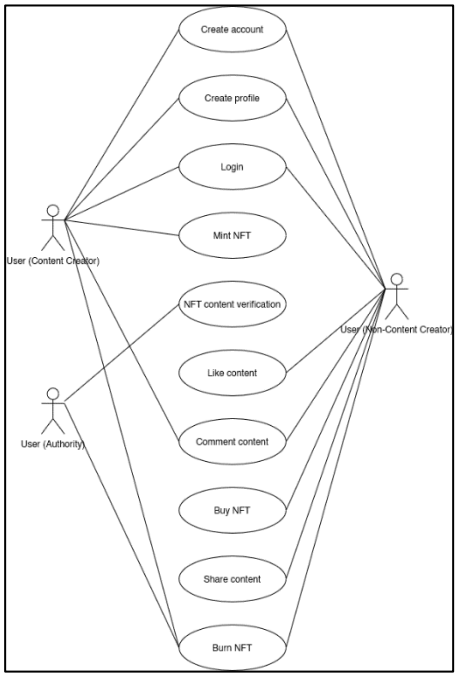

Fig. 14: Use Case Diagram of Decentralized Social Media.

Figure 15-19 describes sequence diagram based on use case interactions. Sequence diagrams are designed based on the interaction between objects and messages conveyed in the processes that occur on the proposed decentralized social media.

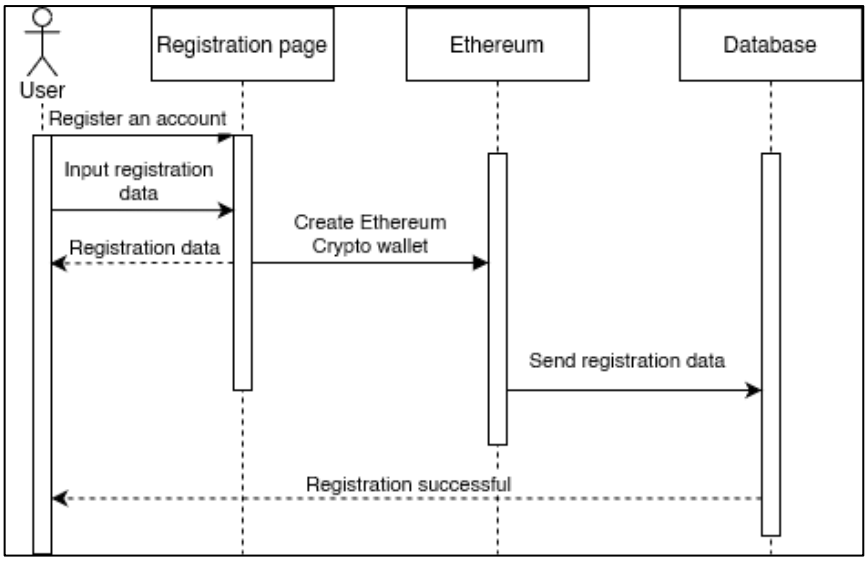

Fig. 15: Sequence Diagram of Register.

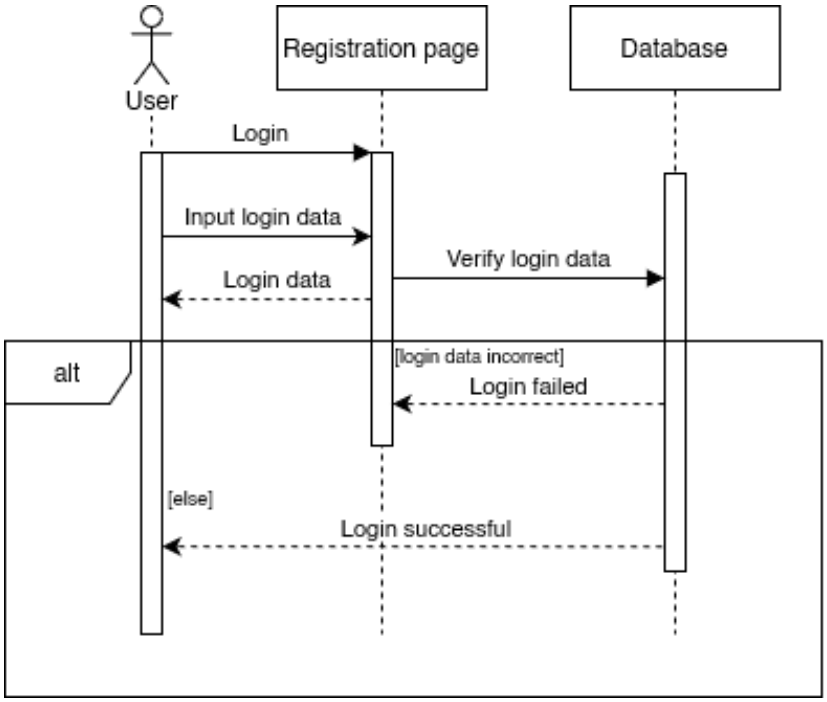

Fig. 16: Sequence Diagram of Login.

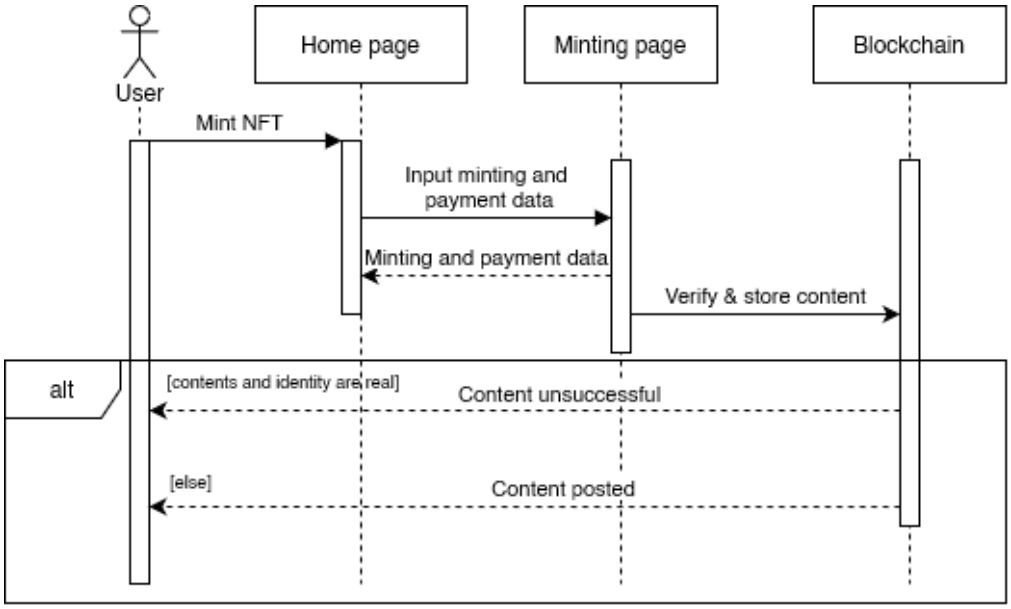

Fig. 17: Sequence Diagram of NFT Minting.

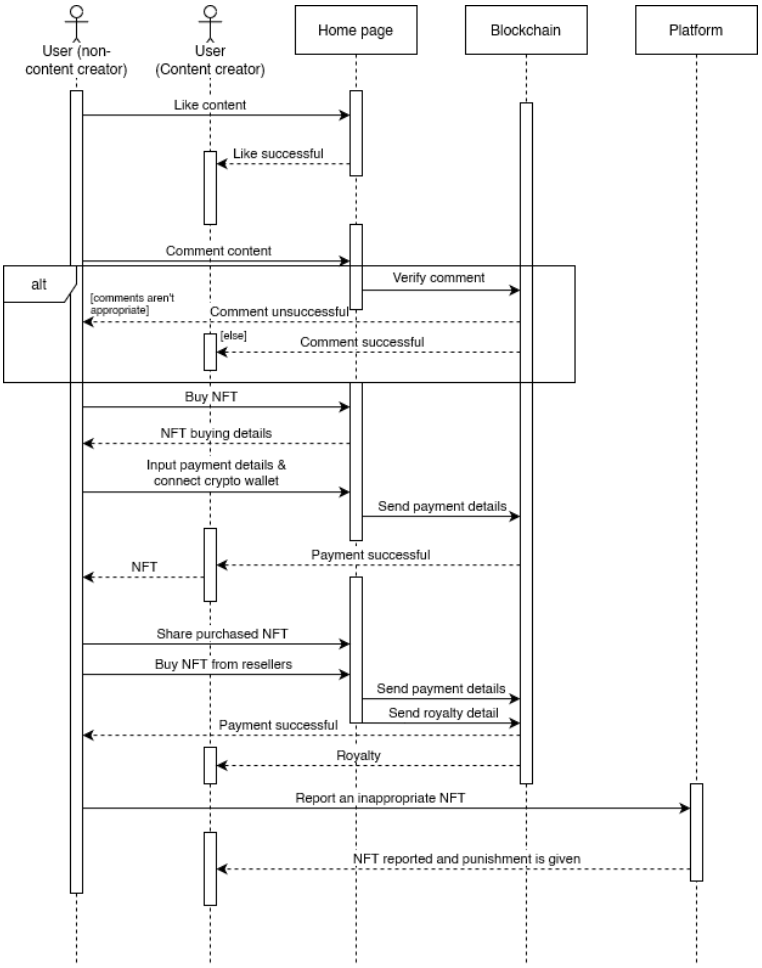

Fig. 18: Sequence Diagram of NFT Transaction.

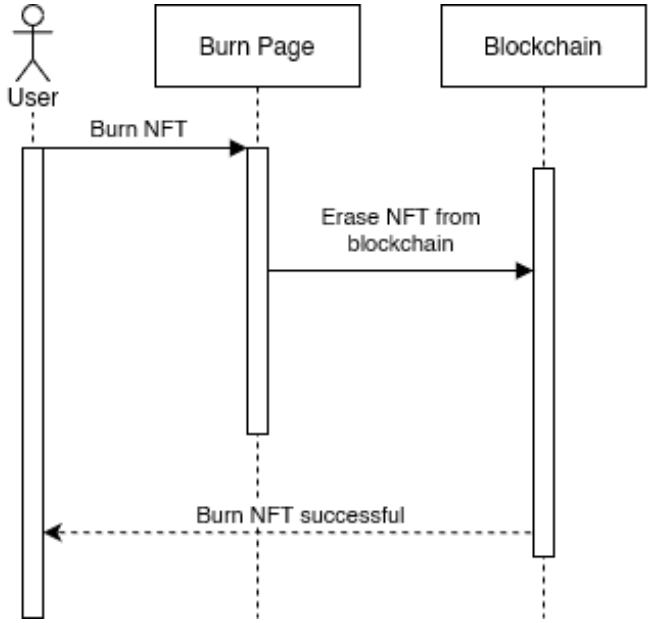

Fig. 19: Sequence Diagram of NFT Burning.

The result of the analysis and system design lead to design of user interface proposed for this decentralized social media platform. Figure 20 and 21 is the register page, which contains some information that user needs to complete, such as real name and profile picture that are mandatory as it is needed to create a profile to store NFT minted by the user, while information such as bio, date of birth, and website are optional.

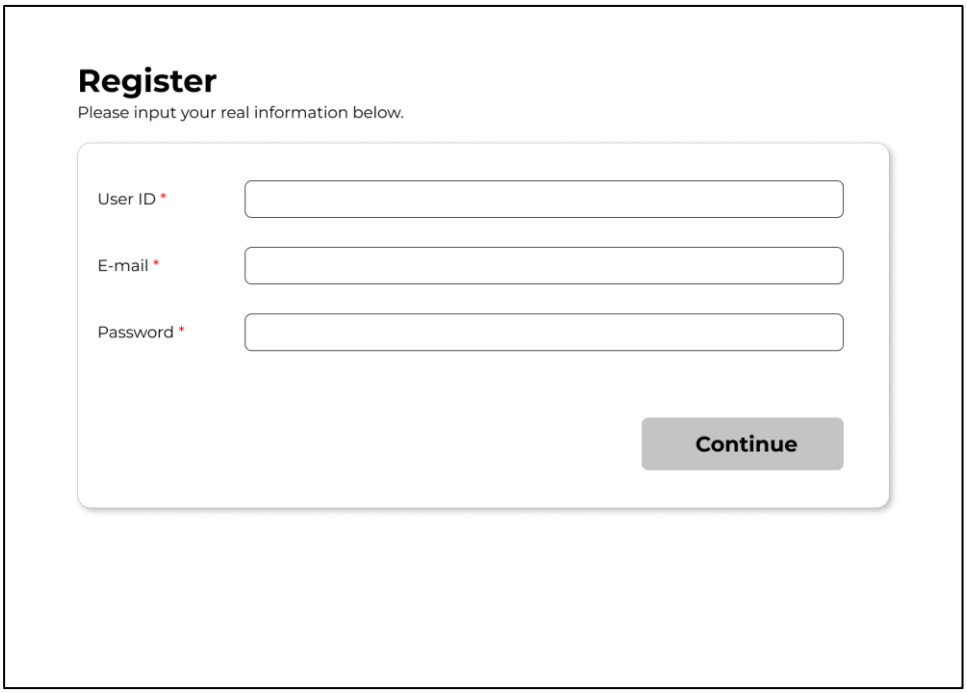

Fig. 20: User Interface of Register Page (1).

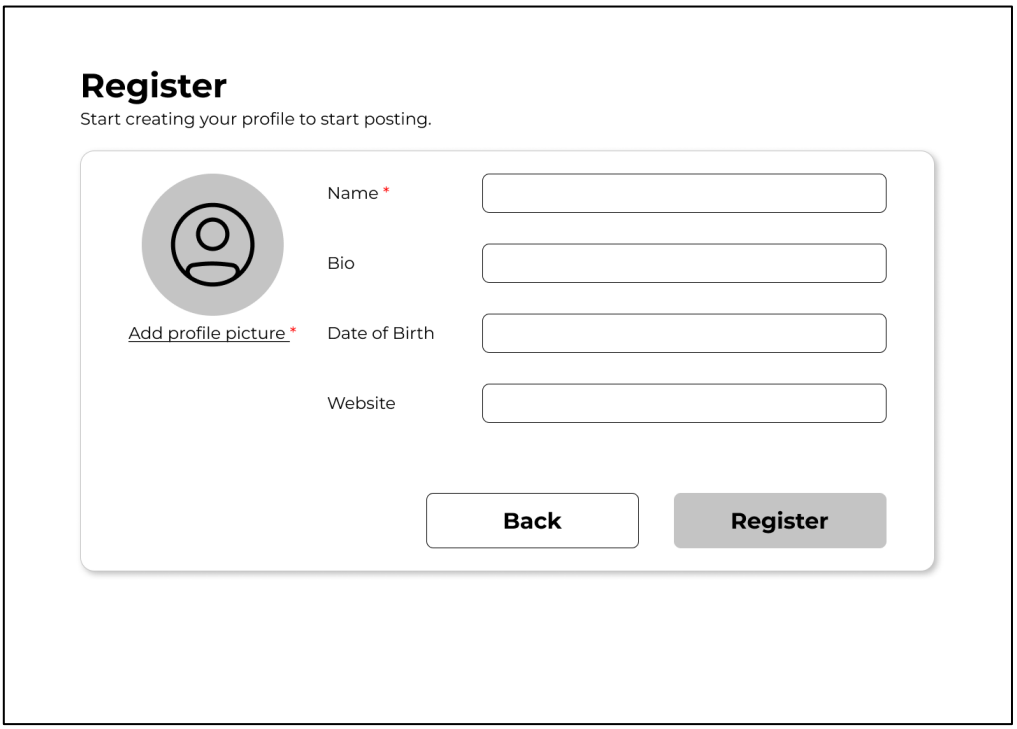

Fig. 21: User Interface of Register Page (2).

After registering an account, user will be leaded to login page as shown in Figure 22.

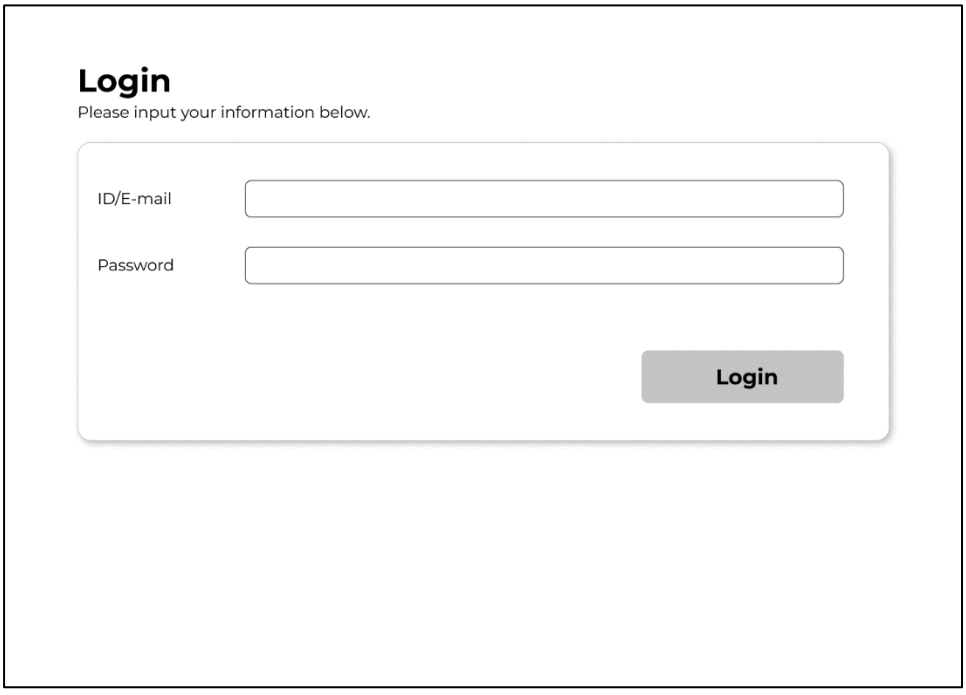

Fig. 22: User Interface of Login Page.

After logging in, user will be leaded to feeds page which shows every content posted in decentralized social media. Figure 23 is feeding page user interface.

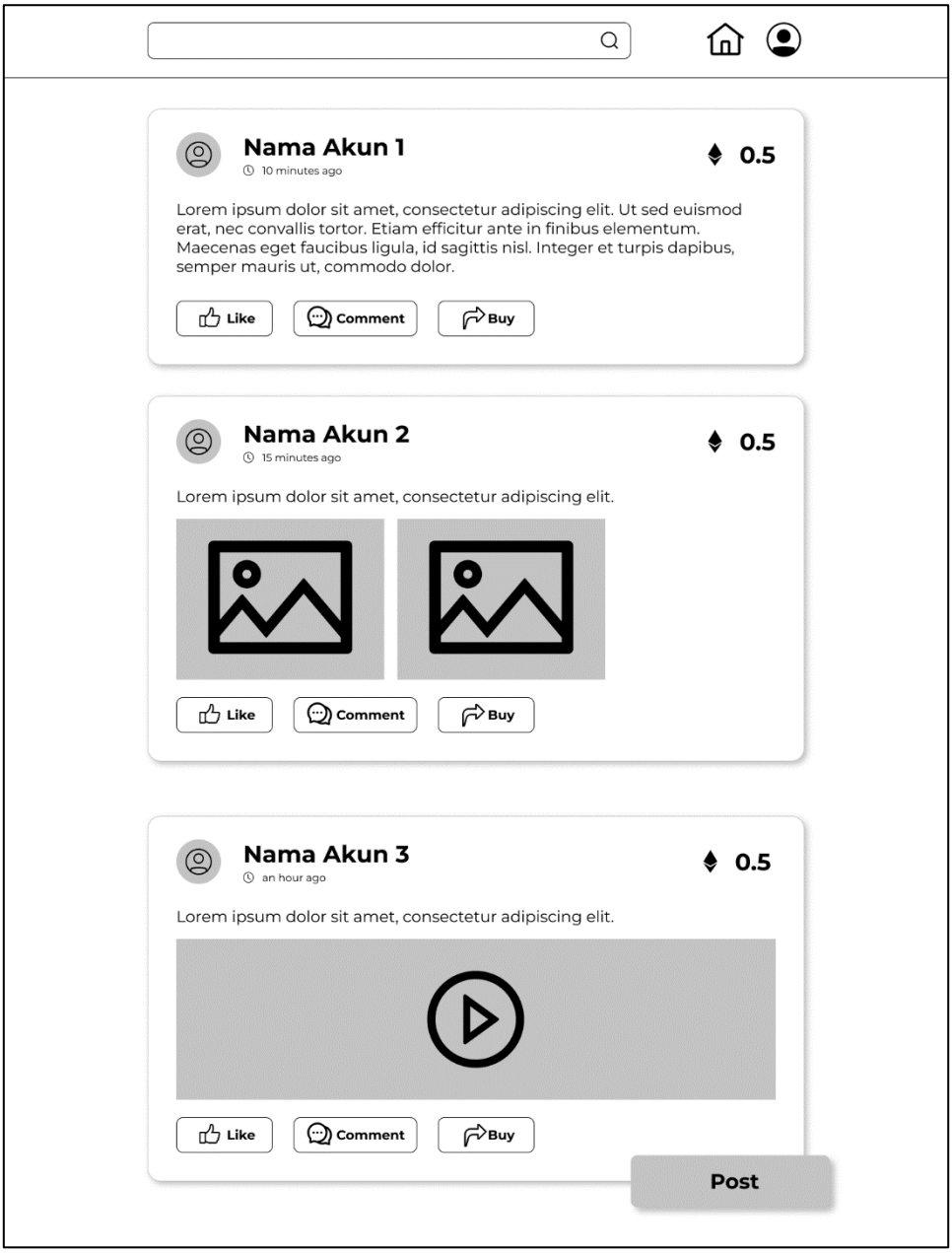

Fig. 23: User Interface of Feeds Page.

User can mint their own contents as shown in Figure 24, by clicking the post button located at the bottom of the feeds screen. Before minting, user needs to input the contents such as articles or captions, photos, videos, or audio; also, price, royalty, and supply of the NFT.

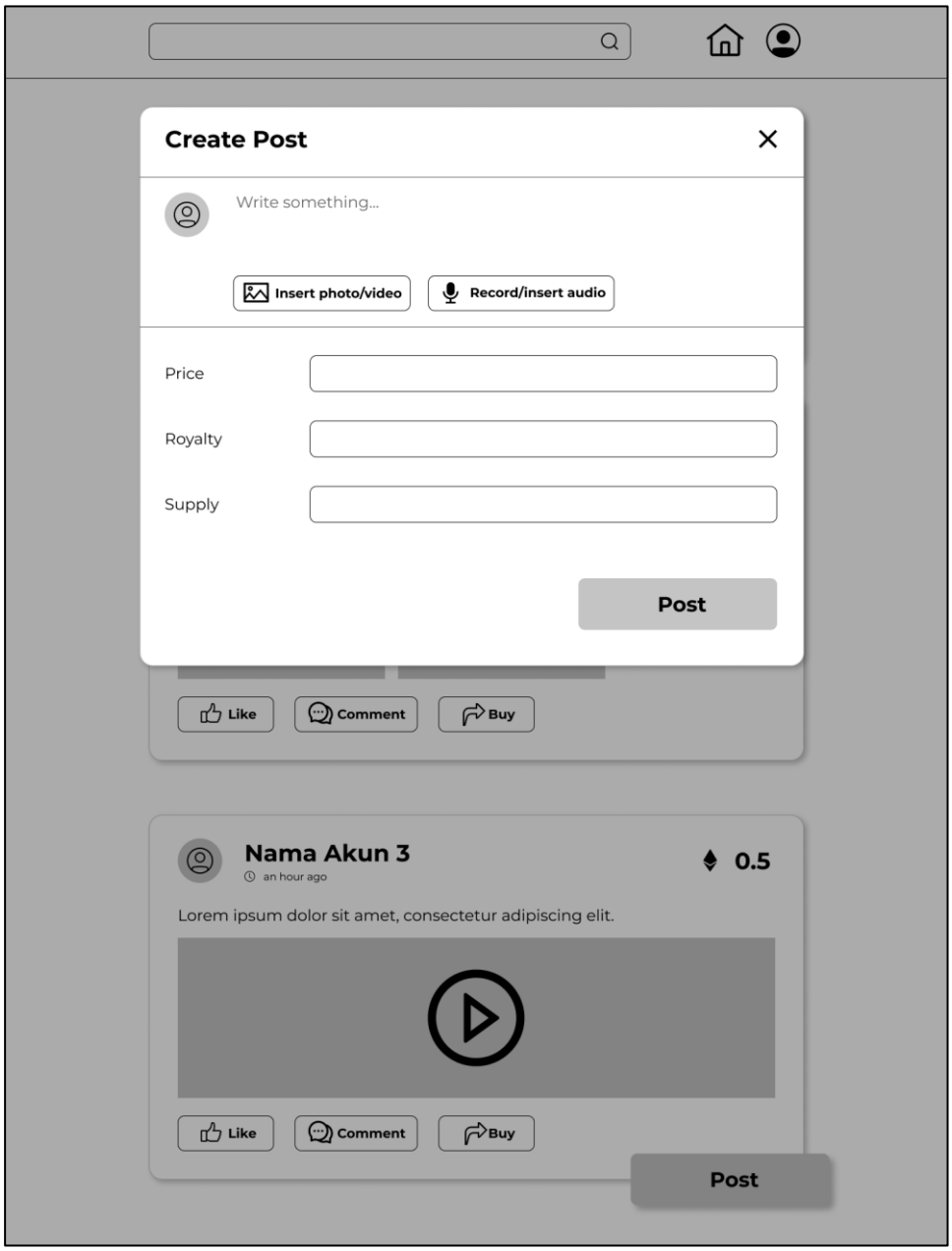

Fig. 24: User Interface of NFT Minting.

Contents that are successful posted will be stored in user's profile as shown in Figure 25.

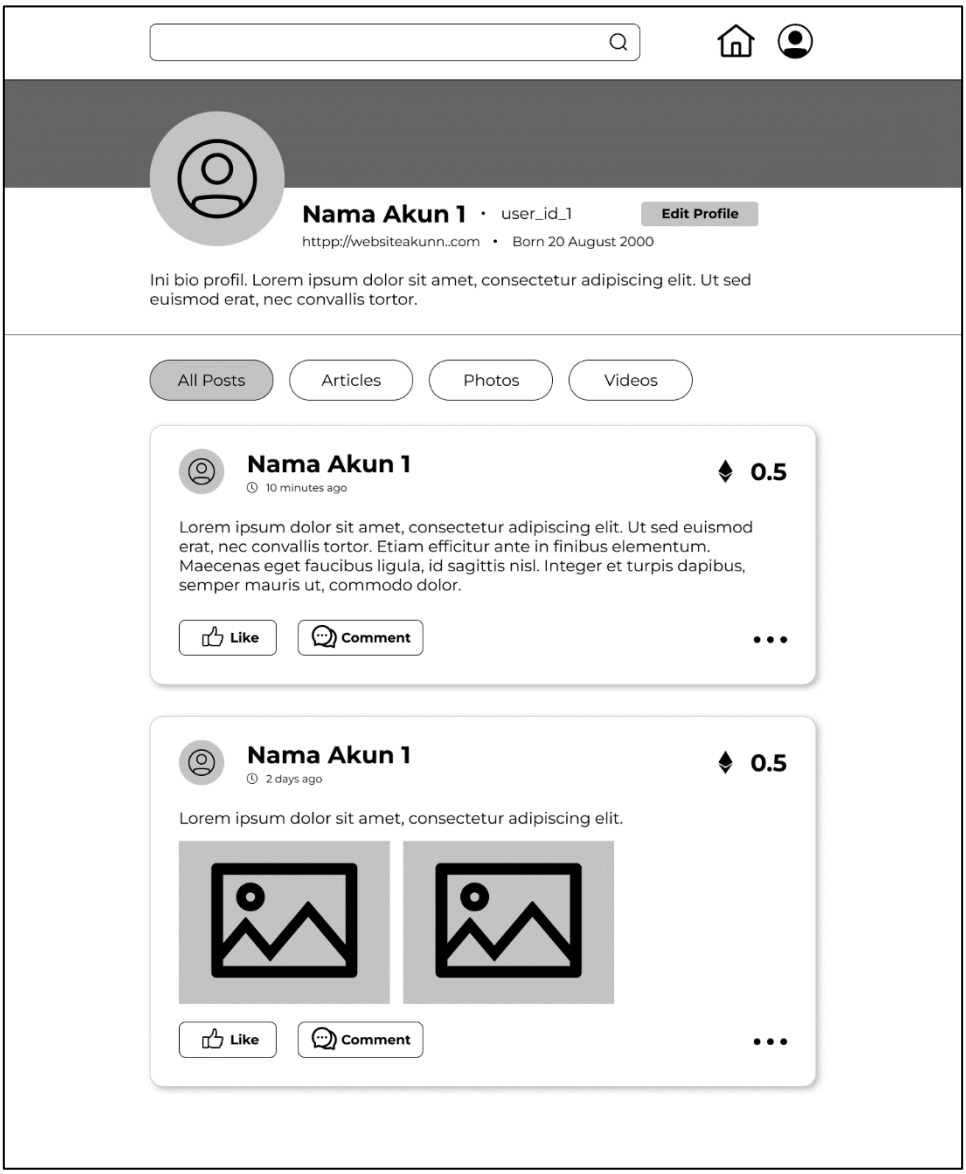

Fig. 25: User Interface of Profile Page.

Users can also buy NFT by choosing one of the contents they want to buy as shown in Figure 26. By buying the NFT, a buyer can reshare it to their profile and resell the content they bought.

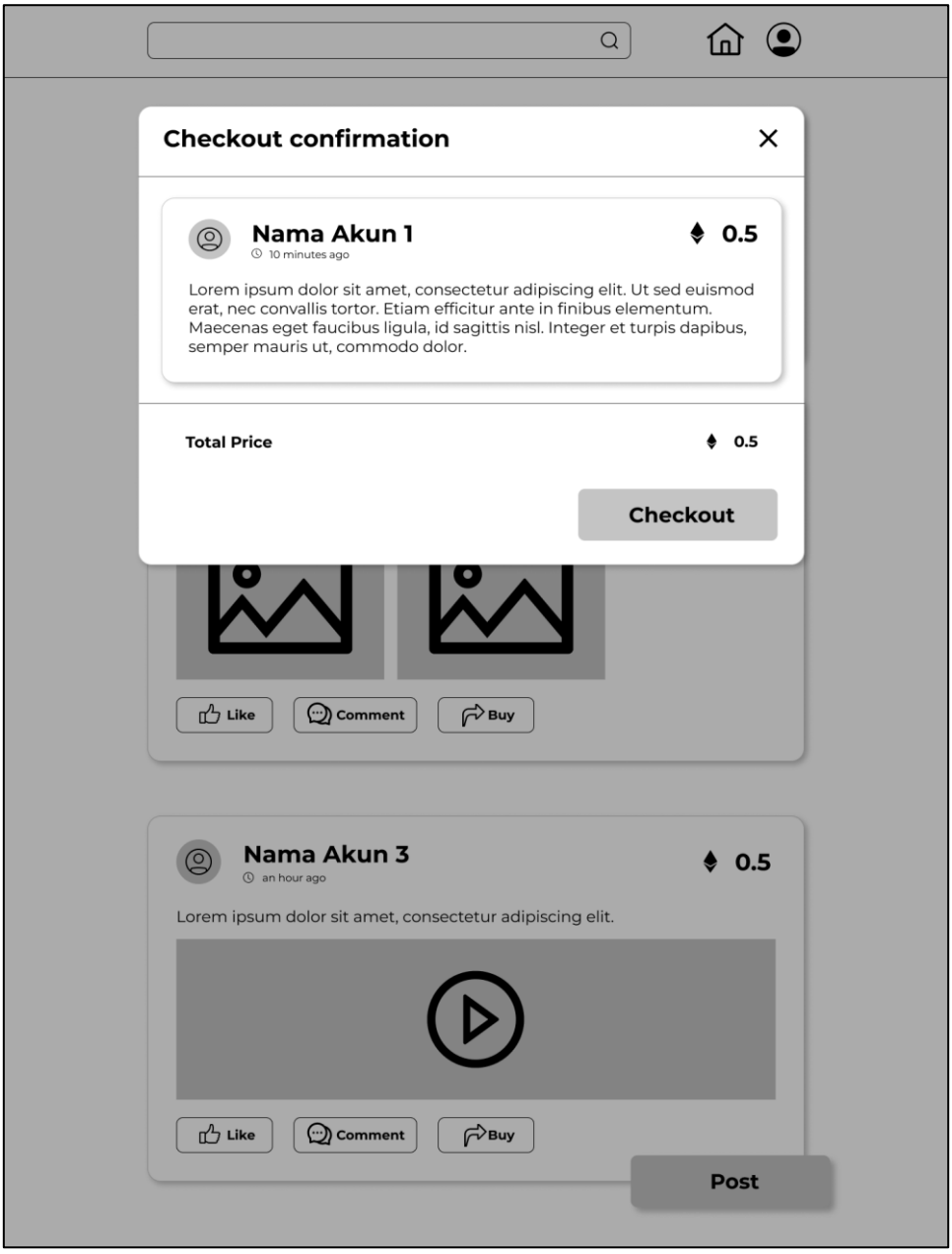

Fig. 26: User Interface of Checkout Confirmation on NFT Buying.

Users can also burn their own NFT by clicking the drop down on every content, as shown in Figure 27.

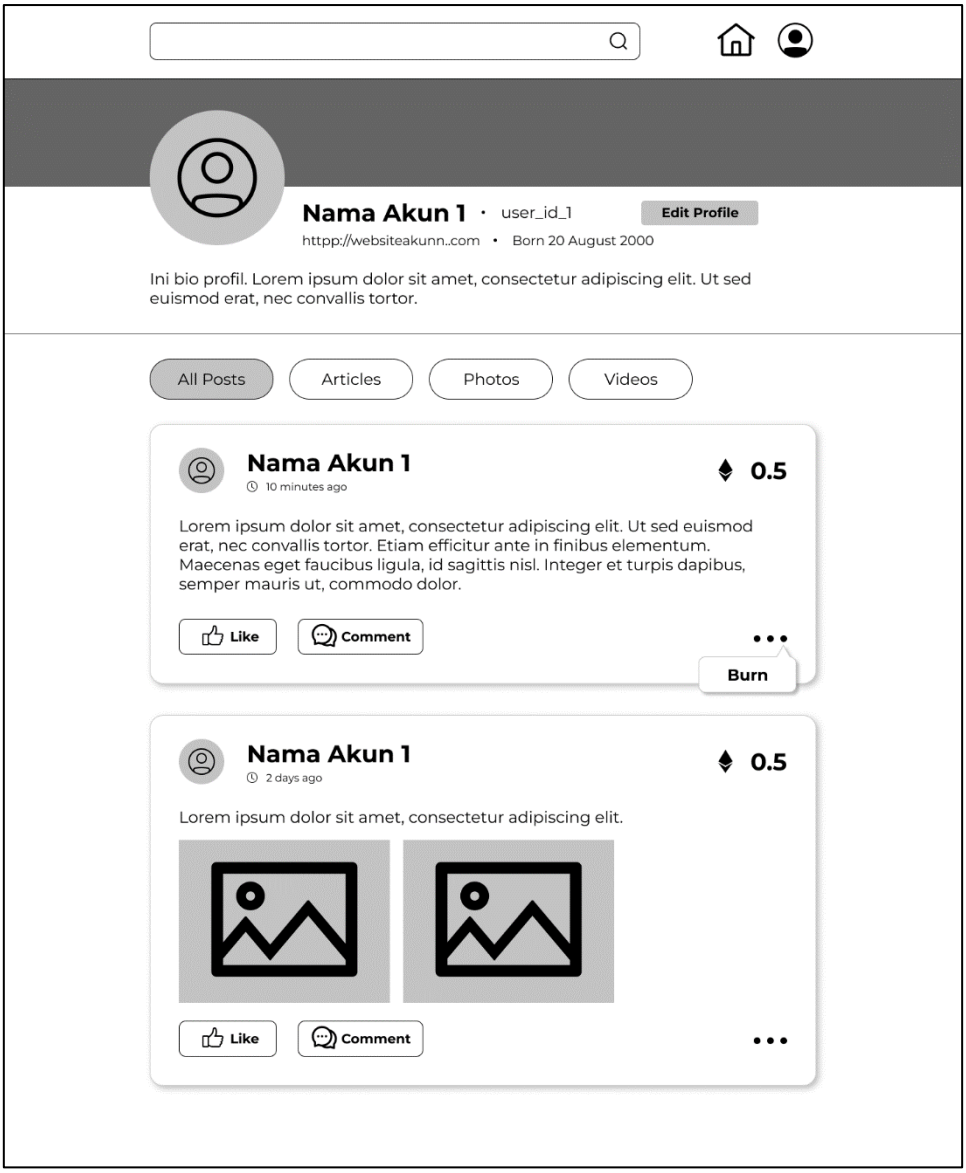

Fig. 27: User Interface of NFT Burning.

4.6. Evaluation, Results and Discussion.

Based on this pre-research, there are several changes that differentiate between centralized social media and decentralized social media, which stated in Table 6.

Table 6. Comparation between Centralized and Decentralized Social Media.

No.	Comparison Parameter	Centralized Social Media	Decentralized Social Media
1.	Features	Contents posted in a form of text, photos, videos; chat and call with other users; like, comment, share	Content posted in a form of text, photos, videos; like, comment, share, ability to monetize contents (NFT)
2.	Monetization by platform	Freemium, advertising, subscription	Minting fee
3.	Monetization by users	Generally, not available, but on some social media share advertising revenue to content creators.	NFT selling and royalties if other users resell owner's contents.
4.	Users who can monetize their content	Regulations who and what contents they can monetize	Every user

No.	Comparison Parameter	Centralized Social Media	Decentralized Social Media
5.	Contents filtering	Unavailable, but platforms tend to censor the contents after being uploaded	Content verifications before uploaded to prevent inappropriate contents

Business process and system design proposed for this decentralized social media platform were validated by expertise of blockchain which is stated in Table 7.

Table 7. Validation Result of Proposed Decentralized Social Media.

No.	Description	Result				
		1	2	3	4	5
1.	Porter's Five Forces Analysis				√	
2.	SWOT Analysis				√	
3.	Business Model Canvas				√	
4.	Business Process (Activity Diagram)			√		
5.	Class Diagram			√		
6.	Use Case Diagram			√		
7.	Sequence Diagram			√		
8.	User Interface				√	

Validation is only carried out by one of the experts in the blockchain field at a private university in Indonesia. Apart from that, a limitation of this research is that the respondents are not yet fluent in BOSM nor Tokenomics. Most Indonesians do not know about blockchain, especially blockchain-based online social media. This is an opportunity for this research, but great effort is needed to seize this opportunity.

5. Conclusion

The following conclusions are stated after going through the following stages of this pre-research. The business processes and tokenomics that occur in the proposed decentralized social media are proses where users need to pay for the minting fee before minting new NFTs in a form of social media contents, however there will be circulation of money where content creators are able to sell their contents and receive royalties when other users sell their contents bought from the original creator. The result of system designs in decentralized social media are class diagrams, use case diagrams, sequence diagrams, and user interfaces designed based on proposed business process. The result of modelling business process and system for decentralized social media is good by average score of 3,5 of 5. In the future, this research will develop the system design that was created in this research. Apart from that, further research will also focus on tokenomics which will be used in decentralized social media.

Acknowledgements

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

References

Aletha, N. O. "Memahami Non-Fungible Tokens (NFT) di Industri CryptoArt," Cent. Digit. Soc., 2021.

Au, S. & Power, T. Tokenomics: The Crypto Shift of Blockchains, ICOs, and Tokens. Birmingham, UK: Packt Publishing, Ltd., 2018.

Booch, G., Rumbaugh, J., & Jacobson, I. The Unified Modelling Language User Guide. Addison Wesley, 1999.

Choi, T. M. & Luo, S. "When blockchain meets social-media: Will the result benefit social media analytics for supply chain operations management?," Transp. Res. Part E Logist. Transp. Rev., vol. 135, no. December 2019, p. 101860, 2020, doi: 10.1016/j.tre.2020.101860.

Christyono, B., Widjaja, M., Wicaksana, A. "Go-Ethereum for electronic voting system using clique as proof-of-authority," TELKOMNIKA, Volume 19, no 5, October 2021, Pages 1565-1572, doi: http://dx.doi.org/10.12928/telkomnika.v19i5.20415.

Cong, L. W., Li, Y., & Wang, N. "Tokenomics: Dynamic Adoption and Valuation," Rev. Financ. Stud., vol. 34, no. 3, pp. 1105–1155, 2021, doi: 10.1093/rfs/hhaa089.

Dennis, A., Wixom, B. H., & Tegarden, D. SYSTEMS ANALYSIS & DESIGN An Object-Oriented Approach with UML, 5th ed. Wiley, 2015.

DeSo: The Decentralized Social Network - DeSo. https://docs.deso.org/#the-deso-advantage-mixing-nfts-and-social-media (accessed Jan. 29, 2022).

Devine, A., Jabbar, A., Kimmitt, J., & Apostolidis, C. "Conceptualising a social business blockchain: The coexistence of social and economic logics," Technol. Forecast. Soc. Change, vol. 172, p. 120997, 2021, doi: https://doi.org/10.1016/j.techfore.2021.120997.

Dhawan, A., Bhalla, M., Arora, D., Kaushal, R., & Kumaraguru, P. "FakeNewsIndia: A benchmark dataset of fake news incidents in India, collection methodology and impact assessment in social media," Comput. Commun., vol. 185, pp. 130–141, 2022, doi: https://doi.org/10.1016/j.comcom.2022.01.003.

Freni, P., Ferro, E., & Moncada, R. "Tokenomics and blockchain tokens: A design-oriented morphological framework," Blockchain Res. Appl., 2022, doi: 10.1016/j.bcra.2022.100069.

Guidi, B. "An Overview of Blockchain Online Social Media from the Technical Point of View," Appl. Sci., vol. 11, no. 21, p. 9880, 2021, doi: 10.3390/app11219880.

Guidi, B. & Michienzi, A. "The decentralization of Social Media through the blockchain technology," ACM Int. Conf. Proceeding Ser., pp. 138–139, 2021, doi: 10.1145/3462741.3466680.

Hua, Y., Ribeiro, M. H., West, R., Ristenpart, T., & Naaman, M. "Characterizing Alternative Monetization Strategies on YouTube," vol. 1, no. 1, 2022, doi: 10.48550/arXiv.2203.10143.

Ismubandono, R. A. F., Hayuhardhika, W., Putra, N., & Pramono, D. "Analisis dan Perancangan Sistem Informasi Eksekutif Dashboard Data E- Government berbasis Service pada Pemerintah Kabupaten Sidoarjo," J. Pengemb. Teknol. Inf. dan Ilmu Komput., vol. 3, no. 11, pp. 10788–10796, 2019.

Kapoor, A., Guhathakurta, D., Mathur, M., Yadav, R., Gupta, M., & Kumaraguru, P. "TweetBoost: Influence of Social Media on NFT Valuation," 2022, [Online]. Available: http://arxiv.org/abs/2201.08373.

Law, A., Tong, Y., & Wen, C. C. "Ethereum Blockchain in Preserving Integrity of Voting System," Appl. Inf. Technol. Comput. Sci., vol. 2, no. 2, pp. 1–20, 2021.

Marchesi, M., Marchesi, L., & Tonelli, R. "An Agile Software Engineering Method to Design Blockchain Applications," Cent. East. Eur. Softw. Eng. Conf. Russ., vol. 14, no. 3, pp. 1–8, 2018, doi: 10.34306/bfront.v1i2.52.

Mnif, E., Mouakhar, K., & Jarboui, A. "Blockchain technology awareness on social media: Insights from twitter analytics," J. High Technol. Manag. Res., vol. 32, no. 2, p. 100416, 2021, doi: https://doi.org/10.1016/j.hitech.2021.100416.

Mujilahwati, S. & Fauziah, S. N. "Pemodelan OOAD Aplikasi Prediksi Harga Sembako Berbasis Android," Antivirus J. Ilm. Tek. Inform., vol. 12, no. 1, pp. 1–7, 2018, doi: 10.35457/antivirus.v12i1.430.

Noor, M. U. "Implementasi Blockchain di Dunia Kearsipan: Peluang, Tantangan, Solusi atau Masalah Baru?," Khizanah al-Hikmah J. Ilmu Perpustakaan, Informasi, dan Kearsipan, vol. 8, no. 1, p. 81, 2020, doi: 10.24252/kah.v8i1a9.

Palanisamy, A., Sefidanoski, M., Koulouzis, S., Rubia, C., Saurabh, N., & Prodan, R. "Decentralized Social Media Applications as a Service: A Car-Sharing Perspective," Proc. - IEEE Symp. Comput. Commun., vol. 2020-July, 2020, doi: 10.1109/ISCC50000.2020.9219617.

Rasheed, M. I., Malik, M. J., Pitafi, A. H., Anser, M. K., & Abbas, M. "Usage of social media, student engagement, and creativity: The role of knowledge sharing behavior and cyberbullying," Comput. Educ., vol. 159, p. 104002, 2020, doi: https://doi.org/10.1016/j.compedu.2020.104002.

Rasidin, M., Witro, D., Yanti, B. Z., Purwaningsih, R. F., & Nurasih, W. "The Role of Government in Preventing the Spread of Hoax Related the 2019 Elections in Social Media," Diakom J. Media dan Komun., vol. 3, no. 2, pp. 127–137, 2020, doi: 10.17933/diakom.v3i2.76.

Rini, L. N. & Manalu, R. "Memahami Penggunaan dan Motivasi Akun Anonim Instagram di Kalangan Remaja," Interak. Online, vol. 9, no. 1, pp. 85–97, 2020.

Saptiawan, I. H. "Dari Anonim Kembali ke Anonim," SeBaSa, vol. 1, no. 2, p. 80, 2018, doi: 10.29408/sbs.v1i2.1036.

Sari, Y. S. "Analysis and Design of Information System Cash Purchase of Jelita Sprey with Object Oriented Methodology," Int. J. Comput. Sci. Mob. Comput., vol. 7, no. 7, pp. 45–57, 2018, [Online]. Available: https://www.academia.edu/download/57015336/V7I7201808.pdf.

Setiawan, D., Saifulloh, & Kurniawan, I. B. "Analisis Dan Perancangan Sistem Informasi LENTERA Untuk Membentuk "Smart Society" Di Lingkungan Kampus Menggunakan Metode OOAD (Studi Kasus : Universitas PGRI Madiun)," Semin. Nas. Teknol. Inf. dan Komun. 2019, pp. 155–159, 2019, [Online]. Available: http://prosiding.unipma.ac.id/index.php/SENATIK/article/view/1133.

Setiyawan, B., Aknuranda, I., & Herlambang, A. D. "Analisis dan Perancangan Sistem Informasi Pelayanan Informasi Pasar Kerja Dengan Pendekatan Berorientasi Objek," J. Pengemb. Teknol. Inf. dan Ilmu Komput. Univ. Brawijaya, vol. 2, no. 9, pp. 2721–2728, 2018.

Song, G., Kim, S., Hwang, H., & Lee, K. "Blockchain-based Notarization for Social Media," 2019 IEEE Int. Conf. Consum. Electron. ICCE 2019, no. March, 2019, doi: 10.1109/ICCE.2019.8661978.

Sunarwoto, A. A. & Said, M. F. "BUSINESS STARTUP: PRINTSHIP," Universitas Bina Nusantara, 2018.

Ur Rahman, M., Guidi, B., & Baiardi, F. "Blockchain-based access control management for Decentralized Online Social Networks," J. Parallel Distrib. Comput., vol. 144, pp. 41–54, 2020, doi: https://doi.org/10.1016/j.jpdc.2020.05.011.

White, B., Mahanti, A., & Passi, K. Characterizing the OpenSea NFT Marketplace. Association for Computing Machinery, 2022.