DESIGN OF NFT SMART CONTRACT SYSTEM USING ETHEREUM NETWORK BLOCKHCAIN TECHNOLOGY

*SENDRINO EDGARD[1], **JAROT S. SUROSO[2]

Information System Management Department, BINUS Graduate Program – Master of Information System Management, Bina Nusantara University, Jakarta, Indonesia 11480
E-mail: sendrino.edgard@binus.ac.id[1], jsembodo@binus.edu[2]

Abstract

In this digital era, the development of information system and information technology has become an integral part of people's daily lives. As it is today, technology has made human life easier in the rise of variety of new innovations in various fields. One of the most rising technologies is blockchain, this technology is considered as important technology system for businesses, it can affect in performance and security of data. This blockchain has a strong system and strong security such as cryptography, peer-to-peer network technology, smart contracts, and consensus mechanisms. With the rise of blockchain, we know that cryptocurrency has been around it, almost all the people like cryptocurrency as the new digital currency which can affect the economy of a country. Further in coming days, digital currency has been connected to digital arts which is NFT, a new way of calling arts and they have good use case for businesses. In this paper, we will see how to develop and design simple NFT web and minting/buying method using Ethereum testing net/environment.

Keywords: *Blockchain, Smart Contract, NFT, Ethereum, Information System, Information Technology, Web*

1. INTRODUCTION

The development and application of information technology has been implemented in almost all companies to increase effectiveness, efficiency, and productivity. According to Indrayani, H. (2012), the development of information technology is important to be able to compete with other companies and keep abreast of developments and advances in information technology. The application of technology helps in improving aspects such as productivity, effectiveness, low costs, and targets are easy to achieve.

Before there were NFTs, digital assets were easily owned by people who weren't the original owners, and that made it difficult for the community. Traditional digital asset system, they cannot be tracked with previous owners and documents are still physical papers which can be destroyed or lost.

Technology has now improved and invent new innovations, the latest and most famous is blockchain. It is used by many cryptocurrencies nowadays to support their environment system.

This very popular technology is the publication of blockchain technology (a distributed database or ledger that is shared among the nodes of a computer network), where the blockchain itself was discovered in 1991 by Stuart Haber and W. Scott Stornetta. Even though this technology had emerged, the application of blockchain was still minimal at that time, as reported by Investopedia.com. Blockchain became known when the publication of a digital currency or cryptocurrency called Bitcoin shake the worlds by the price of just 1 BTC. As reported by cncbcindonesia.com, Bitcoin was created by a person named Satoshi Nakamoto in 2009, the probability this is a fake name. Everyone was interested in this digital currency, it is decentralized and not owned by the government.

Behind the prominence and fame of the digital currency, Bitcoin, the blockchain that forms the basis of the digital currency system has become well known today. Blockchain is a peer-to-peer technology where information is protected with the help of smart contract that is decentralized through peer-to-peer network. In a smart contract, it contains a record of transactions which are usually used in buying and selling digital currency. And each of these transactions is

included in a block that is connected to other blocks. Inside the block there is a unique code (hash) which indicates the identity of the block and transaction. Blockchain technology uses a concept where transaction records are recorded transparently and without any intervened by third parties. Making this as the most trusted technology for transactions. As this technology rise, more innovation came through like transaction between digital currency, NFT and making it as a system for businesses sector to protect data. Cryptocurrency has evolved and produce other crypto startups like Ethereum, Binance and many more.
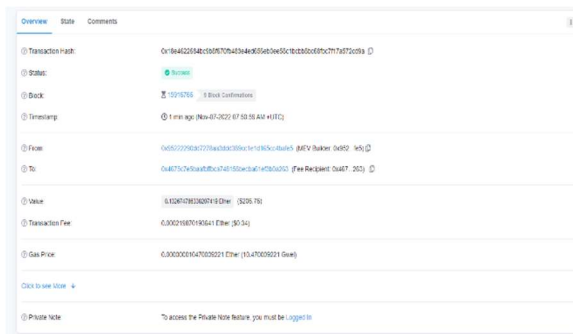

Figure 1.1

From Figure 1.1, this is an example of a smart contract for the Ethereum network. The contents of the Smart contract have a "transaction hash" or what we can call an id or ID with a unique number. There is also the status of the process, the time it takes for the transaction to process. There is also a digital wallet address containing the sender and recipient. Furthermore, there is also the ETH crypto value that is sent and there is also a fee for processing the transaction, which is called, gas fee.

Apart from cryptocurrencies, blockchain technology is also used as an event system for digital images known as, NFT. According to Wang, Q., Li, R., Wang, Q., & Chen, S, NFT is a digital asset in works of art that has unique metadata and is stored in a token form on the blockchain network. The term NFT itself is a non-fungible token. The token can contain anything such as images, songs, or other digital format files. But here the focus is on NFT digital images. The NFT has a token id where each NFT is unique from the others. These digital assets usually issue assets or attributes automatically with the help of coding, this is why NFT produces images that are different and unique because they have been made

in computer language to randomize the attributes of each NFT image. This NFT asset has only one owner and can be traded by other people but only assets can only have one owner because NFT is a "one of a kind" token. If it has been purchased by a requester, the NFT asset holder belongs to that holder and so on, ownership is verified on the blockchain network. During this process interested parties will get NFT randomly with the metadata of the asset. Payments will use crypto and transaction records will be recorded in the blockchain network. NFTs are tokens that possess their own unique characteristics and digital proof of ownership and rarity.

In the Web 3.0 era, NFT can become a payment gateway from traditional methods to digital. Because the NFT itself has a value that can be high or low. But usually when it can become a tool for transactions, the NFT already has a good history, good business prospects and is known by many crypto or NFT enthusiasts.

For crypto and NFT lovers, we must often hear the term smart contract. According to Zou, W., Lo, D., Kochhar, P. S., Le, X. B. D., Xia, X., Feng, Y., ... & Xu, B. (2019) a smart contract is a digital ledger contract that is stored and using blockchain technology. This smart contract is made for users so that all transaction processes can be carried out without the presence of a third party only between two people. Smart contracts are made of computer programming language that contains digital wallet addresses, crypto transaction details and descriptions.

In this paper, we will build a smart contract NFT system design using Ethereum blockchain technology, owned NFT business.

From this research the research questions are as below:
1. Is using Ethereum relevant for NFT projects?
2. What factors influence blockchain adoption for NFTs?

2.   Literature Review

-System Design

System design is designing a system where the contents are the operational steps in making a system and the procedures to support system design operations. Another understanding of system design is the analysis and design of a system.

-Information Systems

Information system is a system that provides information for management in decision making and for the process of business activities every day. The system is a combination or combination of information technology and procedures of an organization. Collection of information and data that is processed to become more useful.

- Web-based understanding

Web-based application is an application that can be accessed using a web browser via a network. Web-based applications can run using browser technology with the HTTP protocol using TCP/IP. There are 3 web communication tools namely TCP, UDP and ICMP. TCP/IP stands for Transmission Control Protocol/Internet Protocol, which is a data communication tool used to exchange data to a computer via the internet network where it processes requests to the server and the server receives the request and provides the results needed by the user. IP is important in calling or communicating between computers via the internet because IP is an address for web data. This application can be accessed anywhere thanks to this web communication system. Browsers that support this are like Google.com where this is an example of a web-based application for accessing websites. In making this NFT web, programming languages such as HTML, CSS and React.js (JavaScript) are needed.

-Web 3.0

Web 3.0 is an internet that has been implemented by several web developers. This web-based application will be able to process information in an intelligent way through AI (Artificial Intelligence) technology with the help of machine learning. Besides that, Web 3.0 is also known as blockchain technology where there is a decentralized digital ledger. Examples of Web 3.0 are dapps (decentralized applications) and defi (decentralized finance).

-NFT

NFT stands for Non-Fungible Token which means something that is unique and cannot be duplicated or replaced. Every NFT has a digital signature which makes each NFT unique and different from the others. Usually, NFT is a digital asset that contains images, video, audio, or other digital formats. Other examples of NFTs are artwork, comic books, sports collectibles, trading cards, games, and many others. Usually, they use ERC-721 tokens which is a token standard that can be found on the Ethereum blockchain.

-Ethereum Network

The Ethereum (ETH) network is not just a crypto or digital currency. When it was first introduced in December 2013 by Vitalik Buterin and his friends, where they are computer programmers and Bitcoin lovers. Ethereum is also an implementation of blockchain technology that is capable of building computing technology on the blockchain. Because of Ethereum, blockchain is not only about digital currency but being transactions between digital assets also through programming languages. This is one of the driving and supporting NFT systems. Ethereum was created because applications built with the Bitcoin blockchain protocol have problems with very large transaction volumes making the value slow. Ethereum can be developed to build applications based on blockchain technology, such as the example of Opensea, Metamask, Uniswap and many more, entrepreneurs use Ethereum as a tool to support the environment, which are named like DAPPS and DEFI.

Ethereum has a component, namely the Ethereum Virtual Machine which makes Ethereum run using a script or programming language called Solidity to build decentralized applications and Ethereum has a token called Ether or ETH where this token can be used as a digital currency like other crypto and can-do transactions between users, cooperation processes such as Bitcoin by way of mining. Storing transaction data on the blockchain with a fee is called a gas fee for data storage on the Ethereum blockchain. Ethereum can be used more flexibly to develop blockchain-based applications that can be managed by consensus.

-Smart Contract Ethereum

Smart contract is a program for implementing blockchain technology which has the goal of determining an agreement between several parties that is used to be applied in coded form as a logical system to be able to interact with the blockchain. This is a solution to the problems that exist in blockchain technology. Can communicate between smart contracts and blockchain. In Ethereum smart contracts is built with a programming language called Solidity, it is used to build applications from there.

-Blockchain

The definition of blockchain that has been explained according to Maesa, D. D. F., Mori, P., & Ricci, L. (2019), that blockchain is a database or digital ledger where the data built cannot be changed, distributed, always available, safe and where data is stored. Data is protected by means of cryptographic security methods so that it is safe.

-Cryptography

Cryptography is a security method technique where writing is written secretly with special characters, using letters and characters outside of their original form. According to Thahara, A., & Siregar, I. T. (2021), cryptography allows someone to send secret messages to other people by using a code system so that they cannot be understood by third parties or bad people such as hackers. Anticipate attacks or interrupts to the system. In other words, it fills the message with a specific algorithm, namely the SHA-256 hashing algorithm (secure hash algorithm), the algorithm used in the blockchain. Hashing algorithm is a process which converts data into other data that has a certain size. Input data becomes output data with a length of 256-bit or 64 characters so that the data will be valid and safe, not easily manipulated. In the input and output results there are changes and differences in the original data.

Figure 2.1

-Waterfall Methods

The waterfall method is a method that focuses on sequential development. The waterfall method starts with conducting a requirements analysis, system design, programming implementation, verification testing and maintenance. The waterfall method is useful in system design because it requires documentation from one phase to the next, if something happens, changes can be documented, and development can be carried out on time.

3.   METHODOLOGY

-System Development

The system development method for designing the NFT system is one of the methods used to produce system processes, methods, and tools. The design of this method is related to smart contract programs and other programming language like Reacts, html and CSS. By using waterfall method, the process will result as below:

A. **Requirements**
In the early stage of Requirements, you must identify all the requirements needed for the development of this system so that you can understand the aspects of the requirements and the web-apps that will be developed.

B. **Designs**
In the next stage, after identifying the needs, namely design, prepare web-apps design plans. Designing helps in determining the requirements and helps in designing the overall system architecture.

C. **Implementation**
After designing the system architecture design, at this stage it is developing the system using a programming language. The design results are converted into program code which is integrated into web-apps.

D. **Verification**
In the next stage, the programming code that has been designed will become a complete system and be submitted or carried out for the testing phase related to the functionality of the system, testing using the Ethereum network. Test transactions using the Ether value according to the smart contract function carried out in a testing environment or test-net.

E. **Maintenance**
The final stage in the waterfall method is to perform maintenance on the system on a regular basis even though it still uses a test-net instead of the main-net. If an error or error is found, there is a system

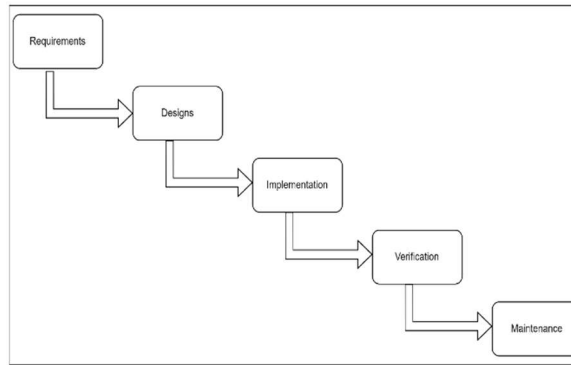repair process, so that it is fixed as soon as possible.

Figure 2.1

-Data Collection

Data collection is a method of collecting and analyzing data, which makes it as information. In this study, the data collection methods are:

- **Observation**
  In this stage, data is conducted by doing observations activities at various Crypto & Blue Chip NFT projects.
- **Literature Review**
  In this stage, data is collected related to research through books, reference articles from the internet.

4. RESULTS AND DISCUSSIONS

-System Design and Planning

The system that will be designed and created is a web 3.0 system, where this website will be the main display for this NFT design and behind it, the back end¸ has a smart contract system that is listed when the user presses the "Mint Now" button. When pressing the button an external DAPPS wallet will appear, namely MetaMask, with this external wallet it will make transactions with the ETH crypto balance in the wallet. After making a transaction, NFT is sent directly to the wallet. The website will use frameworks such as React.js, Hardhat.js. This system was built using the programming languages HTML, CSS, JavaScript, and Solidity (a program for interacting with smart contracts).
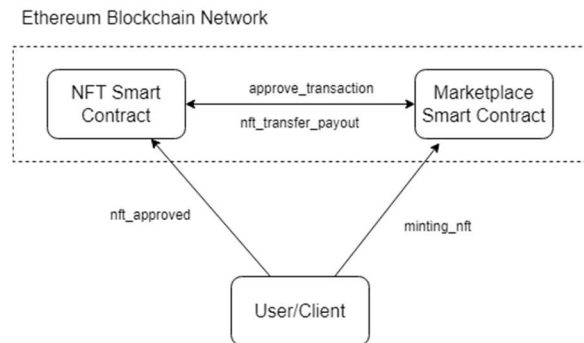

Figure 4.1

The result of this system is to provide convenience about designing smart contract system so that they can get information about this NFT project more clearly.

Strength	Weakness
Unique Ownership	Limited functionality
Potential for innovations	Security

Table 4.1

5. CONCLUSIONS

5.1. Conclusions

From the discussion and design in the previous chapters in this paper, the following conclusions can be drawn:

1. Can provide information about digital assets or NFTs with menus or facilities in this web 3.0. Easy to understand and use by visitors to this web.
2. Using the Ethereum crypto system as a bridge to blockchain technology.

5.2. Suggestions

The development of this web and blockchain-based information system has several suggestions for improvement regarding this NFT planning system. Here's another suggestion to think about:

1. The development of data security systems can be improved.
2. The system that has been created has not been widely promoted because it is still carrying out environmental testing.

REFERENCES

[1] Schollmeier, R. (2001, August). A Definition Of Peer-To-Peer Networking For The Classification Of Peer-To-Peer Architectures And Applications. In *Proceedings First International Conference On Peer-To-Peer Computing* (Pp. 101-102). Ieee.

[2] Nakamoto, S. (2008). Bitcoin: A Peer-To-Peer Electronic Cash System. *Decentralized Business Review*, 21260.

[3] Maesa, D. D. F., Mori, P., & Ricci, L. (2019). A Blockchain Based Approach For The Definition Of Auditable Access Control Systems. *Computers & Security*, *84*, 93-119.

[4] Zou, W., Lo, D., Kochhar, P. S., Le, X. B. D., Xia, X., Feng, Y., ... & Xu, B. (2019). Smart Contract Development: Challenges And Opportunities. Ieee Transactions On Software Engineering, 47(10), 2084-2106.

[5] Wang, Q., Li, R., Wang, Q., & Chen, S. (2021). Non-Fungible Token (Nft): Overview, Evaluation, Opportunities And Challenges. Arxiv Preprint Arxiv:2105.07447.

[6] Ante, L. (2022). Non-Fungible Token (Nft) Markets On The Ethereum Blockchain: Temporal Development, Cointegration And Interrelations. *Economics Of Innovation And New Technology*, 1-19.

[7] Pinto-Gutiérrez, C., Gaitán, S., Jaramillo, D., & Velasquez, S. (2022). The Nft Hype: What Draws Attention To Non-Fungible Tokens?. *Mathematics*, *10*(3), 335.

[8] Vujičić, D., Jagodić, D., & Ranđić, S. (2018, March). Blockchain Technology, Bitcoin, And Ethereum: A Brief Overview. In 2018 17th International Symposium Infoteh-Jahorina (Infoteh) (Pp. 1-6). Ieee.

[9] Pawan, E., Thamrin, R. H., Hasan, P., Bei, S. H., & Matu, P. (2021). Using Waterfall Method To Design Information System Of Spmi Stimik Sepuluh Nopember Jayapura. *International Journal Of Computer And Information System (Ijcis)*, *2*(2), 34-39.

[10] Meimaharani, R., & Fithri, D. L. (2014). Perancangan E-Commerce Goody Bag Spunbond Menggunakan Qr Code Berbasis Web Responsif. *Prosiding Snatif*, 357-366.

[11] Han, C. H., Kim, J. K., Choi, S. H., & Kim, S. H. (1998). Determination Of Information System Development Priority Using Quality Function Development. *Computers & Industrial Engineering*, *35*(1-2), 241-244.

[12] Nadini, M., Alessandretti, L., Di Giacinto, F., Martino, M., Aiello, L. M., & Baronchelli, A. (2021). Mapping The Nft Revolution: Market Trends, Trade Networks, And Visual Features. *Scientific Reports*, *11*(1), 20902.

[13] Regner, F., Urbach, N., & Schweizer, A. (2019). Nfts In Practice–Non-Fungible Tokens As Core Component Of A Blockchain-Based Event Ticketing Application.

[14] Wang, Z., Jin, H., Dai, W., Choo, K. K. R., & Zou, D. (2021). Ethereum Smart Contract Security Research: Survey And Future Research Opportunities. *Frontiers Of Computer Science*, *15*(2), 1-18.

[15] Chohan, U. W. (2021). Non-Fungible Tokens: Blockchains, Scarcity, And Value. *Critical Blockchain Research Initiative (Cbri) Working Papers*.

[16] Popescu, A. (2021, May). Non-Fungible Tokens (Nft)-Innovation Beyond The Craze. In *5th International Conference On Innovation In Business, Economics And Marketing Research* (Pp. 26-30).

[17] Cachin, C., Sorniotti, M. V., & Weigold, T. (2016). Blockchain, Cryptography, And Consensus. *Ibm Res., Zürich, Switzerland, Tech. Rep*, *2016*.

[18] Cao, L. (2022). Decentralized Ai: Edge Intelligence And Smart Blockchain, Metaverse, Web3, And Desci. *Ieee Intelligent Systems*, *37*(3), 6-19.

[19] Wang, Q., Li, R., Wang, Q., Chen, S., Ryan, M., & Hardjono, T. (2022). Exploring Web3 From The View Of Blockchain. *Arxiv Preprint Arxiv:2206.08821*.

[20] Mcnurlin, B. C., & Sprague, R. H. (2005). *Information Systems Management In Practice*. Prentice-Hall, Inc.

[21] Tandra, M., & Suroso, J. S. (2022). Designing A New Cryptocurrency With Hard Fork And Stablecoin Approach As A Disruptive Innovation In Payment System Of International Trade. *Journal Of Theoretical And Applied Information Technology*, *100*(19).