Creation of a Unique University Diploma Based on Non-Fungible Token

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Abstract The educational institution issues a diploma to the student after completing higher education. With the advent of blockchain technology, and then with the spread of NFT (Non-Fungible Tokens), it became possible for educational institutions to issue a unique diploma for the students, which is different in terms of form. This would make the diploma more customizable, which would include the student's emotions, thoughts, and insights expressed in graphic representation. The formally personalized diploma certainly represents even greater value for the students, which they will proudly show to their parents and friends. The purpose of the research is to examine how to create a diploma with NFT elements, as well as to reveal the more important steps of its creation. As part of the practical implementation, I will create an NFT-based diploma. To achieve this, I need a digital wallet, a blockchain suitable for NFT storage, and an NFT marketplace.

Keywords: Blockchain Technology, NFT, MetaMask, OpenSea, Ethereum

Introduction

On March 11, 2021, an exclusively digital piece of art in the form of a non-fungible token (NFT) was sold for the equivalent of $69 million. This work of art by the artist Beeple can be freely viewed or accessed by anyone on the Internet. So why was such a large sum paid for it? Arguably because this piece of art is an NFT. NFTs are blockchain-based tokens that securely map ownership rights to digital assets. Analogous to owning a physical work of art (that visitors to a museum can also look at without owning it), NFTs provide a way to represent ownership or possession of digital assets such as art, music, games, or collectibles [1].

The rapid and dramatic development of information technology, over the recent decade, cannot be denied [2]. Higher education institutions should adapt to the new solutions [3]. The concept of a Non-Fungible Token is essentially a digital diploma of authenticity that cannot be replicated. NFTs are stored on a blockchain or a distributed ledger and are used to represent ownership of unique items. Thanks to the secure proprieties of blockchain technology, the record of ownership is always

available, and immutable and ensures that there can be only one owner at a given time [4].

Today, blockchain technology is still considered a novelty, even though new ideas in this area appear daily. IT professionals are still getting to know blockchain-based solutions and are trying to take advantage of its potential.

NFT-based blockchain technology has not yet spread in university education, although it is already successfully used in many areas [5] such as:

- Typical NFT use cases are related to collectibles, access keys, tickets, and numbered seats for concerts and sports events. ERC-721 (Ethereum Request for Comments 721), standardizes non-fungible tokens by defining an API interface to implement a smart contract on the Ethereum blockchain and by mandating the functionality that such a smart contract must provide. The functionality is mainly related to the transfer of tokens from one account to another, the retrieval of the current balance of a wallet, and the retrieval of the ownership of a specific token [6],
- In the future, official medical certificates will widely use Industry 5.0 technology. However, the Remix Ethereum platform is currently being used in conjunction with the MetaMask wallet to implement the proposed framework for generating medical certificates such as birth, death, and illness certificates [7].

Research is progressing toward the notion of issuing university certificates not only in paper-based form but also as an electronic document, issued through a blockchain, as data stored in a blockchain provides a high degree of security. By the implementation of such a method, the number of misuses could be minimized, as there were several cases of the applicants producing fake diplomas to the employers [8].

The research is structured according to the following structure:

- Choosing the optimal blockchain for storing the university's NFT-based diploma,
- Choosing a digital wallet that supports a blockchain capable of storing NFT,
- Selection of the NFT marketplace, where the university can most effectively sell its diploma containing NFT elements to its students,
- Creating an NFT-based diploma.

1 Creating a Unique Diploma

1.1 Choose a Blockchain

To create an NFT-based diploma, you must first select the necessary blockchain on which you can store NFT. These may include:

- *Ethereum - Blockchain.*

In practice, NFT is derived from the Ethereum token standard, which aims to make each token distinguishable and completely unique [9]. Ethereum is a popular NFT blockchain. Using the ERC-721 (Ethereum Request for Comments 721) standard, it is possible to create NFTs on it, which are stored in the blockchain. Example functionalities ERC-20 provides:

- Blockchain,
- Transfer tokens from one account to another,
- Get the current token balance of an account,
- Get the total supply of the token available on the network,
- Approve whether an amount of token from an account can be spent by a third-party account [10]

Ethereum is one of the most reliable and stable blockchains on the market.

- *Solana – Blockchain*

The purpose of the Solana protocol is to create and operate decentralized apps. To effectively solve the problem of scalability, the blockchain is the so-called It uses a combination of proof of history and proof of stake algorithms, and the result is an extremely short validation time for both transactions and the execution of smart contracts. All of this is achieved at a very low network fee, which is why Solana has attracted the interest of both corporate and private investors. Solana offers transaction fees of less than $0.01 and a growing list of supported apps for NFTs [11].

- *Flow – Blockchain*

Flow is a fast, decentralized, and developer-friendly blockchain, the goal of which is to create an ecosystem where a new generation of online games and dApps (decentralized apps) can see the light of day. All forms of use and applications of the protocol require the possession of the Flow token, and the cost of blockchain interactions must also be paid with Flow. In addition, Flow is suitable for obtaining rewards on the network, for transaction validation, or for development. Network management, like other proof-of-stake blockchains, is also in the hands of token

holders. Flow is a PoS blockchain designed for NFTs and decentralized gaming applications and hosts the popular NBA Top Shot NFT collection [12].

Unfortunately, Solana's network has experienced test issues more than once, even though it is a very good and forward-looking blockchain. It is advisable for the university to choose a blockchain that has operated stably for many years and is not in danger of being discontinued. The Flow blockchain is only two years old. The possible errors inherent in it have certainly not been revealed yet. Therefore, I chose the Ethereum blockchain for the practical implementation.

1.2 Set Up an NFT Wallet

It is necessary for the university to create an NFT wallet so that students can pay for their NFT-enhanced diploma. Creating an NFT costs money, which the student must pay. In essence, this would be an added extra service from the university that the student could request if they wanted to customize the look of their diploma. The creation of the NFT primarily includes the cost of the university graphic designer and the purchase of blockchain storage space. The university can pay the NFT with its students using a digital wallet. These may include:

- *MetaMask*

MetaMask is an open-source Ethereum wallet that supports all Ethereum-based tokens (such as those following the ERC-20 standard or non-fungible tokens). What makes MetaMask to link to web pages. For other wallets, you'll need to copy payment addresses or scan a QR code on a separate device. special is its ability With the MetaMask extension, the website simply searches for the wallet and asks its owner to accept or reject the transaction [13].

MetaMask includes a secure identity store that can be used to sign blockchain transactions on various websites with the user's identity and account. The MetaMask add-on can be installed in Chrome, Firefox and Opera [14].

- *Coinbase Wallet*

Coinbase is a DeFi wallet that does not own the wallet's private keys. If their funds are lost, there is no guarantee that they will receive compensation from the service provider. As a result, users have more control over their funds. With Coinbase Wallet, private keys are encrypted on your computer. The only way for Coinbase to decrypt your wallet is to enter your password [15]. These types of software wallets are vulnerable to hacker attacks because the keys are stored on the computer. However, the latest mobile wallets already have ARM TrustZone for protection, which guarantees adequate security [16].

- *Ledger Nano X*

Hardware wallets offer much more security than web wallets. They exist in physical form and are capable of generating public and private keys. The keys are stored on a device that is not connected to the Internet, so it is more difficult to steal them. These wallets are considered one of the most secure options for storing cryptocurrencies. When we want to use the wallet, it must be connected to the computer [17].

The application of the hardware wallet is characterized by continuous remittance. If, for example, we want to exchange our coin on the exchange, it must first be transferred to the exchange. This entails several error possibilities, such as choosing the wrong deposit address or the wrong blockchain for the transfer. It is recommended that the university choose this solution when it wants to keep the coins in the long term and does not plan to make frequent transfers from one address to another.

During the practical implementation, I used the MetaMask wallet, as it is easy to use, which can presumably be an important aspect for the university as well. First, I installed the software and then I created the MetaMask wallet. This is a very important step as this is where MetaMask enters the Secret Backup Phrase. This must be stored in a safe place because if it is lost, we will not be able to access the amount in the wallet, and if hackers get it, they can steal all the digital currency stored in it.

Since blockchain creates new blocks by solving mathematical algorithms in a decentralized manner, its operation can be trusted. Since it is based on the operation of algorithms, the centralized banking system can be bypassed, the consequence of which is that in case of theft, the cryptocurrency will be lost, and no one will reimburse the amount to the customers. To prevent crypto money from being stolen by unauthorized persons, the Secret Backup Phrase must be stored in a safe place.

1.3 Choose an NFT Platform

The university must choose the NFT platform that best suits it, where it can sell the prepared NFT-based diploma to its students. Before this, however, the NFT wallet must be connected to the NFT platform so that the payment can take place. Before selling the student's NFT-based diploma, you must make sure that the NFT diploma is purchased by the student who is entitled to it. This is a key factor in the entire solution, as the reputation of the university may be damaged in the event of incorrect sales. The university should choose from the following NFT platforms:

- *OpenSea*

OpenSea is a very popular crypto market dealing with the buying and selling of NFT. OpenSea was launched in November 2017, but today a total of 10 million digital objects from more than 300 projects are listed on it. Crypto collections, domain names, and other NFTs can all be found, and the tokens of supported

projects can be accessed from your own Ethereum wallet. ERC-721 and ERC-1155 tokens can be found and traded on the platform. Regolit, mycryptoption [18],

- *Solanart*

Solanart was released in 2021. To date, it has been used by 233,000 merchants and generated sales of $657 million. The advantage of Solanart is that it processes data both off-chain and on-chain. Featured NFTs are all displayed in real-time, thus supporting trading. Solanart users are always informed about the most popular NFTs [19].

This is a very useful function, but the university does not need it, since only our own students sell NFTs.

- *Binance Exchange*

Today, there are more than 100 cryptocurrency exchanges. which have different in-depth technical competencies, such as security, liquidity, transaction speed, coin variety, low fees, deposit options, and mobile applications to attract investors. Binance has the highest volume among the crypto exchanges [20]. In addition, it also has its own coin with BNB [21]. On the Binance exchange, it is possible to create NFT directly. It is an easy and simple solution to create NFT and even to pay coins you don't have to leave the exchange. However, in my opinion, if the university is thinking long-term about creating NFT-based diplomas, it is more appropriate to choose a solution that is not so universal, as it has more options for personalizing NFTs.

1.4 Create the NFT

The creation of the NFT-based university degree consists of the following important steps. This is shown in the first figure.

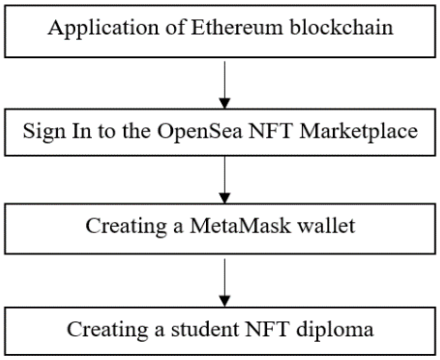

Figure 1
The process of creating an NFT-based university degree

The last step is to create the NFT image. All NFTs are built from layers. This means that the images can be placed on top of each other. In this case, each image represents a layer. The images must have a PNG extension, this ensures that the NFT will have a sharp image. In the case of the university, the basic layer is the university diploma itself, on which the other layers can be placed, and this makes it unique. To create image layers, it is advisable to use the following software:

- Photoshop,
- Figma,
- Corel,
- Illustrator.

I used the open-source Hashlips Art Engine to create a unique image. With the help of this, I modified the metadata in the main, js file in the ERC 721 smart contract from the point of view of the uniqueness of the appearance of the university diploma. This is shown in the second figure.

```
name: '${namePrefix #${edition}`,
description: NFT_based_diploma
file_url: '${baseURI}/${_edition}.png',
custom_fields: {
dna: sha1(_dna),
edition: _ university edition1,
date: dateTime,
compiler: "Hashlips Art Engine".
},
…extraMetadata,
attributes: attributesList,
},
ff (network = Solana) {
tempMetadata & {
```

Figure 2

Smart Contract metadata

With the help of an Ethereum smart contract, the university can determine the cost of issuing a diploma containing NFT elements. Since the Smart Contract is part of the blockchain, it is also completely transparent and unforgeable. In this way, abuse during payment can be avoided. The third figure presents the payment mechanism of the Smart Contract.

```
1 contract University NFT diploma{
2 uint public price ;
3 uint public university's stock ;
4 /.../
5 function updatePrice ( uint _price ){
6 if ( msg. student == university )
7 price = _price ;
8 }
9 function buy ( uint quant ) returns ( uint ){
10 if ( msg. value < quant * price || quant > stock )
11 throw ;
12 stock -= quant ;
13 /.
```

Figure 3

Sale of university study materials using a Smart [5]

Each NFT diploma can be connected to a node node, therefore its parameters can be set with the following settings, which is demonstrated in the fourth figure.

```
Student node 1
nohup geth        --nousb \
--datadir=$pwd \
--syncmode 'full' \
--port 20241 \
--networkid 1112 \
--miner.gasprice 0 \
--miner.gastarget 470000000000 \
--http \
--http.addr 192.168.1.24 \
--http.corsdomain '*' \
--http.port 8971 \
--http.vhosts '*' \
--http.api admin,eth,net,txpool,student,\
--mine \
--allow-insecure-unlock \
--unlock "0x7Bb542DEd40d0E6Bd01a1bAe39e47ztr436E48" \
--password - diploma
```

Figure 4

Creation student diploma node

2 Possible Disadvantages od Using an NFT-Based Diploma

The NFT-based diploma must also reflect uniformity in terms of customization since without this it becomes difficult to be easily identified. Since the NFT diploma differs in appearance from the usual uniform university diploma, it can be assumed that many people will try to fake it and thereby deceive future employers.

Ethically, the appearance of the NFT diploma must be regulated primarily at the university level. The appearance of the diploma must match the university's regulations and its interests, as well as it must contain forward-looking solutions, since without this, its introduction becomes unjustified.

Another disadvantage of using an NFT-based diploma is that its production is a power-intensive operation since it works on a blockchain basis. For this reason, it is advisable to choose a blockchain that uses a consensus mechanism that requires less electricity. Instead of PoW (Proof-of-Work), it is recommended to use Pos (Proof-of-Stake) or POA (Proof-of-Authority) solutions.

Conclusions

The diploma containing NFT elements is currently considered a novelty, which has not yet been applied by educational institutions. A degree customized in its formal appearance is considered a forward-looking solution. In my opinion, the diploma loses none of its value if it contains NFT elements.

For the university to create an NFT-based degree, it needs an IT specialist with graphic design skills. It would be his responsibility to design the appearance of the diploma, after consulting with the student. After that, the appearance should be examined and approved by the university in every case.

Creating such a diploma comes at a cost, which would burden the student. The university must also be open to accepting cryptocurrencies since the most straightforward way for the student to pay for the unique diploma is with the help of the blockchain. With the use of the MetaMask wallet, the student would transfer the cost of issuing the diploma in Ethereum.

Upon entering the OpenSea Marketplace interface, the diploma would become available to the student, which only he or she could purchase. The university should pay a lot of attention to this so that it only sells the diploma to students who are entitled to it.

References

[1] Phuong. T. Mai and Andrea Tick: Cyber Security Awareness and behavior of youth in smartphone usage: A comparative study between university students in Hungary and Vietnam, Acta Polytechnica Hungarica, 18(8), 2021, pp. 67-89.

[2] Ante Lennart: Non-fungible token (NFT) markets on the Ethereum blockchain: Temporal development, cointegration and interrelations, Economics of Innovation and New Technology, 2022 pp. 1-19.

[3] Mónika Garai-Fodor: The Impact of the Coronavirus on Competence, from a Generation-Specific Perspective, Acta Polytechnica Hungarica 19.8 (2022): pp.111-125.

[4] Andrei Popescu: Non-Fungible Tokens (NFT)-Innovation Beyond the Craze, 5th International Conference on Innovation in Business, Economics and Marketing Research, 2021, pp. 23-30.

[5] Krisztian Bálint: Creation of a Unifie University Blockchain for the Purpose of Storing the University's Teaching Materials, IEEE 17 th International Symposium on Applied Computational Intelligence and Informatics (SACI 2023), Timisoara, Romania, 2023, pp.159-164.

[6] S. Casale-Brunet, P. Ribeca, P. Doyle, M. Mattavelli: Networks of Ethereum Non-Fungible Tokens: A graph-based analysis of the ERC-721 ecosystem, 2021 IEEE International Conference on Blockchain (Blockchain). IEEE, 2021, pp. 185-195.

[7] C. Rupa, D. Midhunchakkaravarthy, M. Kamrul Hasan, H. Alhumyani, A. Saeed: Industry 5.0: Ethereum blockchain technology-based DApp smart contract, Math. Biosci. Eng 18.5, 2021, pp. 7010-7027.

[8] Krisztian Bálint: Possibilities for the Utilization of an Automatized, Electronic Blockchain-based, Students' Attendance Register, using a Universities' Modern Security Cameras, Acta Polytechnica Hungarica, DOI: 10.12700/APH.18.2.2021.2.7, 18(2), 2021, pp. 127-145.

[9] Q. Wang, R Li, Q. Wang, S. Chen: Non-fungible token (NFT): Overview, evaluation, opportunities and challenges, Computer Science, arXiv preprint arXiv:2105.07447, 2021.

[10] M. Jithil: ERC-20 Token Standard - Ethereum Foundation, https://ethereum.org/en/developers/docs/standards/tokens/erc-20/ (accessed: 2023.02.09), 2023.

[11] D. Solana: Transaction Fees, https://docs.solana.com/transaction_fees (accessed: 2023.02.09), 2021.

[12] NBA Top Shot, Support: The Flow Blockchain, https://support.nbatopshot.com/hc/en-us/articles/1500002632021-The-Flow-Blockchain (accessed: 2023.02.09), 2022

[13] Binance: Using MetaMask, https://academy.binance.com/hu/articles/how-to-use-metamask#install-metamask (accessed: 2023.02.09), 2022.

[14] K Bhosale, K. Akbarabbas, J. Deepak, A. Sankhe: Blockchain based secure data storage, International Research Journal of Engineering and Technology (IRJET) 6.3, pp.5058-5061, 2021.

[15] C. Vantage: Metamask vs. Coinbase Wallet, https://www.cryptovantage.com/best-crypto-wallets/metamask-vs-coinbase-wallet/ (accessed: 2023.02.09), 2022.

[16] H. Rezaeighaleh, and C. Zou: New secure approach to backup cryptocurrency wallets, 2019 IEEE Global Communications Conference (GLOBECOM). IEEE,2019, pp. 1-6.

[17] K Biernacki, M Plechawska-Wójcik: A comparative analysis of cryptocurrency wallet management tools, Journal of Computer Sciences Institute 21, 2021, pp. 373-377.

[18] C. Regolit: How do we use OpenSea's platform?, OpeanSea Introduction and Guide https://mycryptoption.com/hu/news/hogyan-hasznaljuk-az-opensea-platformjat-opeansea-utmutato-kezdoknek/ (accessed: 2023.02.09), 2023.

[19] A. Gomez: Solanart NFT Marketplace - What Is it and How Does it Work?, https://cyberscrilla.com/solanart-nft-marketplace/ (accessed: 2023.02.09), 2022

[20] A. Faruk Aysan, A. Islam Khan, H. Topuz, A. Semih Tunali: Survival of the fittest: A natural experiment from crypto exchanges, The Singapore Economic Review, 2021, pp.1-20.

[21] M. Disli, F, Abd Rabbo, T, Leneeuw, R, Nagayev: Cryptocurrency comovements and crypto exchange movement: The relocation of Binance, Finance Research Letters 48, 2022.