NFT based model to manage educational assets in Metaverse

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Abstract

Abstract— Blockchain has become a trend in the last few years due to its financial impact correlated to Cryptocurrency. Blockchain is a distributed, immutable, and decentralized database to store transactions which are done by users without the need for a trusted Third-party. Similar to cryptocurrency, tokens are objects that Represent digital or physical assets over a Blockchain network. Token market value has been dramatically increasing in the last few years due to The breakthrough that was made in preserving intellectual property And the usage in many other fields like tourism, education, and Art. Non- Fungible tokens (NFT) Are unique and exchangeable tokens because they are different in type and value due to their scarcity. Using NFT to manage the educational assets will be an effective way to protect the intellectual property and the educational assets from fraud. In this paper, we propose a NFT-based framework to manage the educational assets on the Metaverse that authenticate the ownership of the assets using Blockchain technology. We also explain the minting process we used to convert the assets into NFT in the framework.

Keywords: Blockchain, Smart contract, NFT, Metaverse

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1. Introduction

Blockchain is a distributed, and immutable ledger to store transactions done by users without the need for a trusted third party [1]. Blockchain was firstly used for financial purposes, as in Bitcoin and Ethereum. A smart contract is a selfexecuting contract written as a code where some predefined terms and conditions must be valid for executing it. Smart contracts enable the transferring of assets between buyers and sellers without a trusted third party. Blockchain uses smart contracts to enable transferring assets and then recording the transactions of assets to the ledger [2].

1.1. NFT technology:

NFTs are the non-fungible part of Ethereum Blockchain network which has its unique value. NFTs are unique digital assets contains unique identification address and metadata stored over Blockchain network [3]. NFTs are programmed due to a predefined standards like ERC-721 and ERC-1155. NFTs can represent both physical or digital assets. The process of representing physical assets in NFT called Tokenization. Tokenized assets can be divided into two categories: Fungible which are identical and can be replaced with each other's and non-fungible which are different in type and value so it can't be replaced with other non-fungible tokens [4]. Most of NFT's characteristics are derived from Blockchain technology which is the base of NFT.

1.2. Components of NFT:

Each token has token symbol, Token ID, Unique token contract address, creator address, transaction history and the metadata which is the actual content of the token [5]. While metadata may have huge volume which leads to high expenses to store it over Blockchain it is stored off chain being and then a link of it is hashed and then stored over Blockchain. Storing metadata of NFT off chain then hashing it's link and attach it to the NFT is an effective way to reduce the cost of minting NFT for the educational assets.

1.3. NFT's Protocols and standards:

1.3.1. ERC-20:

ERC-20 is a standard proposed by Fabian Vogelsteller in November 2015 for FTs. The standard assumes Tokens to be exactly the same in type and value. ERC-20 can be used to represent a vote in elections, a stake in market, a copy of a book and many other applications [6]. The standard provides a basic functionality to transfer tokens, and allow tokens to be approved which enables third party to spend the tokens. Using ERC-20 on smart contracts enable many functions like: transferFrom which takes sender and receiver addresses and the amount as an input to send an amount of crypto from sender to receiver. Approve which takes an address and the amount requested as an input. The function approve if an amount of token in the account can be spent by another account. balanceOf which takes an address as an input and returns the balance of an account with that address as an output.

1.3.2. Fabtoken:

Fabtoken is a token management system that enables developers to issue, transfer, and redeem tokens using Hyperledger Fabric [7]. The issuer defines the type and quantity of the asset that will be represented as tokens and then assign the

tokens to its original owner. Transferring tokens can by done only by current owners to new owners over the network by using Unspent Transaction Output (UTXO) model to validate the transactions. Tokens are stored in the network and can be owned by any member within the network. Fabtoken authenticates the ownership of tokens by using membership services of Fabric. The transactions of tokens considered valid only if it is done by the owner and valid membership service provider of Fabric.

1.3.3. ERC-721:

ERC-721 was proposed by William Entriken, Dieter Shirley, Jacob Evans, Nastassia Sachs in January 2018. The ERC-721 is a NFT standard which assume every token to be unique in term of type and value from the other tokens in the same smart contract due to its rarity, quantity, and age [8]. ERC-721 was firstly used in the Cryptokitties project which is a game enables players to buy, sell and breed crypto cats as NFTs. For any ERC-721 contract contract address and uint256 tokenId must be unique. ERC-721 standard provides basic functions to transfer tokens from one account to another, get the current token balance of an account and identify the owner of a token. balanceOf which takes an address as an input and returns all NFTs owned by that address as an output. safeT ransferFrom which takes addresses of sender and receiver and tokenID as an input to enables the Transferring of the ownership of an NFT from one address to another. approve which takes an address and tokenId as input and return a bool value to enable or disable approval for a third party.

1.3.4. ERC-1155:

ERC-1155 was proposed by Witek Radomski, Andrew Cooke, Philippe Castonguay, James Therien, Eric Binet and Ronan Sandford in July 2018. The standard aims to enable smart contract to represent and control both FTs and NFTs at the same time [9]. While ERC-20 and ERC- 721 require a separate contract to be deployed for each token type ERC-1155 enable smart contract to check the balance of many owners, transfer multiple token types at once and approve a third part to control the manage all tokens at a single contract which reduce the transaction cost. ERC-1155 has the ability of transferring many assets at the same call by using safeBatchT ransferFrom which takes the sender, receiver addresses, values and IDs of tokens that we want to transfer as an array as an input and transfer them from the sender address to the receiver address. balanceOfBatch which takes The address of the token holder and the IDs of tokens as an input and returns the owner's balance of the token types requested This function also enables to take the balances of many addresses by one call by fill addresses to owner array. setApprovalForAll takes an address and bool value to enable or disable approval for a second party/operator address to manage all tokens.

Fig. 1. Comparasion Between NFT protocols

	ERC-20	Fabtoken	ERC-721	ERC-1155
Supports FT	✓	✓	✗	✓
Supports NFT	✗	✗	✓	✓
Support Multi token types in single SC	✗	✗	✗	✓

1.4. Advantages of NFT Technology:

NFT depends on Blockchain technology which uses a distributed network to store data. Data and transactions among Blockchain are tamper-resistant which means when an transaction

is added to the chain it cannot be deleted or modified. There are many advantages of using NFT we some of them are provided as follow: Proof ownership: NFT assigns the ownership of an asset to a specific owner [10]. When a NFT is registered over Blockchain it cannot be modified or deleted and this enable owners to guarantee their ownerships of assets. Easy ownership transform: Owners of an asset can transfer the ownership of their NFTs easily over Blockchain network [11]. Authenticity: When a NFT is minted it is recorded over Blockchain network with a unique contract address and that enables owners to ensure their NFT's while it is recorded over Blockchain.

1.5.. Why NFT for educational assets?

NFT started to be used in art works, Fashion and luxury, gaming, Social tokens and many other fields in industry due to it's ability to preserve rights on an artworks and protect the intellectual property. Here are some advantages of using NFT for educational assets: Data ownership: While the minted NFT is stored over Blockchain network its ownership is guaranteed also the educational institute who mint the NFT is the owner of it and the only one who can have control over it. Data uniqueness: While the minted tokens have unique address it cannot be modified or replicated and this afford the uniqueness of the educational assets. NFTs are uniquely identified and have different values due to their scarcity, age, and type. Deploying NFTs on smart contracts enables the creator to prove the existence and the ownership of the assets which can be physical like houses, antiques, and arts, or digital like tickets, game characters, and pictures. This feature makes NFT a good solution for protecting intellectual property. Ethereum introduced the ERC- 721 standard byWilliam Entriken, Dieter Shirley, Jacob Evans, Nastassia Sachs in February 2018 followed by the ERC- 1155 standard which is known as the multitoken standard by Witek Radomski, Andrew Cooke, Philippe Castonguay, James Therien, Eric Binet, Ronan Sandford in July 2018 to support NFTs. Metaverse became a trend in industry and academia especially when Facebook changed its name into "Metaverse" in 2021. The usage of Metaverse increases the efficiency of education, entertainment, and social networking and the other systems that can be online accessed. Usage of Metaverse has increased dramatically in recent years due to the features provided to users.Usage of Metaverse has increased dramatically in recent years due to the features provided to users. Metaverse integrates the real world with the virtual world then allowing people who are represented as an avatars to do activities like trading, educating, and social networking. Avatars are the virtual copy of the users which has the same rights and authority of the real world users. Metaverse can be used by the educational institutes to create classes and provide courses in it. The need to preserve theintellectual property of materials that will be used in Metaverse classes and to protect the certificates issued by that educational institutes from fraud modification.

2. Related Works

2.1. NFTCert

NFTCert is a framework to issue NFT based certificate instead of paper format [12]. Due to this framework companies and international universities can authenticate the educational certificates of students depending on NFT. The framework uses

private Blockchain architecture which forces the educational institutes and universities to get a permission of joining the network before accessing the certification services.

2.2. Blockchain for education

Blockchain for Education is an educational certificate issuing perspective based on Blockchain [13]. It guarantees the protection and verification of certificates without the return to the issued authority. The system allows to identify the identity of authorities who can issue certificates, Allow the authorities to issue the certificate, and allow third parties to verificate the issued certificates.

2.3. Decentralized Storage of Educational Assets Using NFTs And Blockchain Technology

In this paper they propose a decentralized educational model to authenticate the educational certificates of students [14]. The model validates the certificates of students through Blockchain and IPFS (interplanetary File System). The integration between Blockchain and IPFS allow to store reduce the fees of minting the educational certificates over Blockchain.

2.4. Blockcerts

Blockcerts is an open standard that allow to verify and issue official records like course licences, and academic credentials [15]. The system allows the educational institutes to issue educational certificates based on the credentials given by the students. The credentials are hashed on the Blockchain and then sent to the recipient who can give it to the verifier who will check the Blockchain to verify the certificate.

3. The Proposed Method

In this paper, we propose a NFT based model to manage the educational assets in Metaverse. The model protects the educational assets from fraud operation and preserve the intellectual property of the educational assets. When an asset is recorded over Blockchain as NFT it own the following features: All the assets are recorded over the distributed ledger of Blockchain which makes it resistant to fraud or modification operations. When the asset added and the NFT minted it cannot be edited or removed even by the owner. The model uses IPFS (InterPlanetary File System) to avoid the big costs of storing big files over Blockchain. IPFS can handle all kinds of data Documents, Images, and videos that makes it appropriate for preserving the intellectual property of multimedia. Using IPFS for storing the files will enable us to store big sized file and only the link of that stored documents will be added to the NFT. The model will be run as shown in the figure Below.

Table 1. comparasion of existing Blockchain based educational management systems

THE PROPOSED METHOD	YEAR	OBJECTIVE	Support educational certificates	Privacy of personal information	Supports other educational assets	Applicable with Metaverse	Supports Multimedia	
Blockcerts	2016	*Allow educational institutes to issue certificates based on student's credentials.*	✓	✓	✗	✗	✗	*Allow educational institutes to issue certificates based on student's credentials.*
Blockchain for education	2018	*Guarantee the protection and verification of certificates without third party.*	✓	✓	✗	✗	✗	*Allow third parties to verify the issued certificates.*
NFTCERT	2021	*Issuing NFT based certificates instead of paper format.*	✓	✓	✗	✗	✗	*Enables overseas universities and international companies related to it's private Blockchain to authenticate the educational certificates of students.*
Decentralized storage of educational assets using NFTS and blockchain technology	2022	*Authenticate student's certificate using blockchain.*	✓	✓	✗	✗	✗	*Using IPFS to store high amount of data instead of storing it over Blockchain.*
Our proposed system	2022	*Protects the educational assets from fraud operations and preserve the intellectual property.*	✓	✓	✓	✓	✓	*Protect the educational assets including Multimedia in Metaverse using NFT.*

Fig.3. Flowchart of minting a NFT record in the proposed model
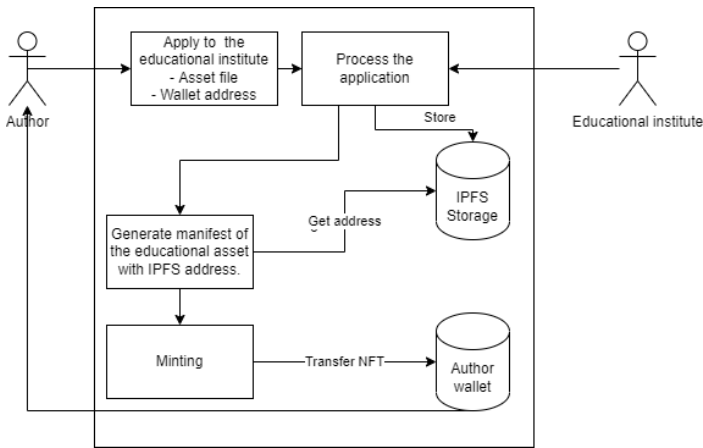
Firstly owner of the asset apply for the educational institute and provide the asset with his/her full information. The educational institute starts minting process by storing the educational asset on IPFS or the web. Then creates a JSON file that refers to the stored document. JSON file contains the information of asset owner. JSON schema considered as a digital educational asset that prove the property of that asset. After creation of JSON file it is attached to the NFT by the educational institute and treated as a token over the network. Finally the educational asset is transferred to it's owner wallet. We also introduced Use case diagram for Registering an asset is running as follow: User request to register the asset from the educational institution. User then pay the fees of registration plus fees of SC(Smart contract deployment). When the fees paid the educational institute deploy a smart contract to mint the NFT belong to the asset and record it to the Blockchain.

Fig.4 . Usecase diagram for registering an educational asset
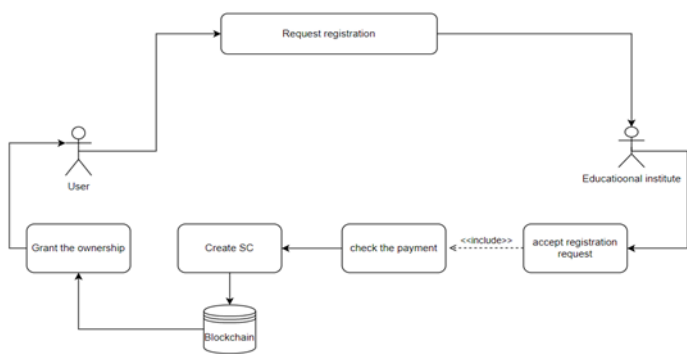
4. Conclusions and Recommendations

In this paper we concluded the systems and model proposed to manage the educational certificates and assets using Blockchain. Then we introduced our proposed model to aim to protect the intellectual property and stop fraud operations of the educational assetsby representing the educational assets as NFT and manage it over Blockchain in Metaverse.

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