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Non-Fungible Tokens (NFT) – Innovation beyond the craze

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Abstract— **The COVID-19 pandemic has pushed digitalization and digitization across all industry sectors and blockchain is considered an innovative frontrunning technology with regards to applicability and usability in these challenging times.**
Blockchain technology has enabled access, through the process of tokenization, to assets that, until now, could not be traded quickly and easily. Tokenization is one of the cornerstones of Decentralized Finance (DeFi) and a native functionality of multiple blockchain architectures. The properties and features of a token unlocks a variety of economic possibilities, besides the main function of using it as fuel for the network itself.
A basic definition of a token refers to a digital asset that is created, issued and managed on a Blockchain or Distributed Ledger Technology (DLT) infrastructure, and is designed to be highly secure with an instant transferability property. With the advancement of smart contracts, some built-in functionalities have been developed and programmed, which helped push the tokenization process to new heights. From real estate security tokens that represent fractionalized properties to platform-specific tokens that incentivize the use of a particular application, tokens have emerged as a secure and digital alternative for users across the world to access, trade and store value.
The Content Creators and Art industry is going through a paradigm shift with the introduction of Non-Fungible Tokens (NFTs), as the space is acquiring a large number or artists hoping to capitalize on the innovation and distribution power that blockchain technology is offering. What digitization first removed from art, blockchain is trying to bring it back, reshaping the art world with viable tools for provenance, authenticity and distribution.
In this paper we will assess the innovative approach of NFTs in different sectors, with an in-depth analysis of their usability and impact. We will be focusing on the features of NFTs to ensure scarcity, traceability and proof of ownership, amongst the most essential properties needed to create, store and maintain the value of an asset.

Keywords— **Blockchain, Digital Assets, Non-Fungible Tokens, Decentralized Finance.**

I. Introduction

Technology progress and digitization was not always considered a partner for the arts industry evolution. This opinion and mindset is about to change.

Content creators, artists and personalities across many industries have dominated the headlines with their involvement in different projects of Non-Fungible Tokens. This pivoting in the face of traditional business models has been achieved by acknowledging the powerful tools and innovative features offered by blockchain technology.

The usability of such technology has been directly proportional with the discovery curve of novel business concepts involving tokens and processes of tokenization.

A token is a digital representation of a good, service or other form of value or utility. Within the realm of digital assets, the tokens are representatives of value like: a stake, a voting right, a toll, a currency, a store of value, ownership rights or multifunctional access within an ecosystem.

The token doesn't have value in, or of itself, and the value comes from the asset it represents. When someone creates a token that represents any of the aforementioned types of services and goods, it's fulfilled through a process of tokenization.

In the context of economics, the term of "fungibility" is the ability of a good or asset to be interchanged with other individual goods or assets of the same type [9]. Fungible assets simplify the exchange and trade processes, as fungibility implies equal value between the assets.

A Non-Fungible Token is a representation of a unique digital asset that cannot be equally swapped or traded for another NFT of the same type.

The concept of a Non-Fungible Token is essentially a digital certificate 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, immutable and ensures that there can be only one owner at a given time.

Based on the blockchain programmable infrastructure, NFTs can represent in a digital realm anything that is both physical or digital. It's important to acknowledge that the metadata which is stored within the smart contract of the token ensures uniqueness and, along with the transparency of the history of transactions provided by the underlying technology, allows the NFT to be verifiable by any of the network participants, reducing the risk of counterfeiting to zero.

The data collected for this article was gathered from concepts and platforms like Minty.Art, OpenSea, Rarible, SuperRare, Atomic Assets, Known Origin, Nifty Gateway, Decentraland and NFT Showroom ([3], [7], [10]-[12], [15], [16], [18], [19]).

II. Research Methodology

A theoretical research methodology was applied in order to identify various concepts, models and trends within the digital assets segment, combined with an empirical qualitative approach that was used to validate the findings and conclusions within this article.

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The qualitative thematical analysis is necessary for a better understanding of the characteristics and components that define Non-Fungible token as an important innovation within the class of Digital Assets.

III. The Internet of Assets

In the real world, financial institutions have numerous ways of valuating assets. To achieve an accurate valuation, it's often necessary to engage with an outside auditor or a rating agency, procedure that comes at a great expense. Subsequently, many assets remain undervalued or outside of the market bounds, leading to a lack of trust for asset owners. The concept of Proof-of-Asset allowed digital representation of a various types of assets on the blockchain.

NFTs are creating a new digital infrastructure based on the concept of Proof-of-Asset. COVID-19 pandemic has pushed digitalization in all market sectors and, as everything is replicated in a digital environment, there is a real need to provide some specific properties to these digital assets like uniqueness, scarcity and proof of ownership.

The Ethereum foundation [8] has presented a comparison between the internet of today and a future representation of an NFT ecosystem-based internet:

TABLE I
NFT Internet vs Today's Internet

NFT Internet	Today's Internet
NFTs are digitally unique; No two NFTs are the same.	A copy of a file, like an .mp3 or .jpg, is the same as the original.
Every NFT must have an owner and there is an easy verifiable process for everyone to acknowledge.	Companies with digital items must build their own infrastructure. For example, an app that issues digital tickets for events would have to build their own ticket exchange.
Content creators can sell their work anywhere and can access a global market.	Creators rely on the infrastructure and distribution of the platforms they use. These are often subject to terms of use and geographical restrictions.
Creators can retain ownership rights over their own work, and claim resale royalties directly.	Platforms, such as music streaming services, retain the majority of profits from sales.
Items can be used in surprising ways. For example, you can use digital artwork as collateral in a decentralized loan.	

Source: Ethereum Foundation , 2021 – Non-Fungible Tokens (NFT). Retrieved from https://ethereum.org/en/nft/#internet-of-assets

The main proprieties and characteristics that we have identified in the ecosystem of NFTs are:

- **Limited Supply** – NFTs are issued in a limited number of units, so you can't have an issuing flow of NFTs with the same value proposition.
- **Non-interoperable** – This propriety refers to the feature that any asset is identified and represents a unique item within its own ecosystem. It cannot have the same representation within a similar environment. An analogy of this characteristic is that an in-game character or item is valued, as such, in that particular game and cannot be used in the same manner in another game or environment. It applies in the same way to any collectible, memorabilia or trading cards.
- **Indivisible** – It's important to acknowledge that a NFT is represented as a whole item and cannot be divided into smaller denominations.
- **Indestructible** – The technology that drives NFTs enhances these assets with the propriety of being immutable. All the metadata which is stored via smart contracts in the blockchain cannot be replicated, removed or destroyed, granting ownership rights of the NFT, to the wallet or peer that possess it.
- **Verifiable** – The process of authentication is also provided by the underlying features of the blockchain technology. This allows a traceability within the ledger as all the transactions are historically registered and stored within the blocks of data. This property allows any NFT attached to an artwork to be traced back to the original creator, eliminating the need of a third-party authentication method.

IV. Digital Scarcity

Internet has granted all of us access to limitless content, with all type of digital media that can be easily shared and replicated, with or without the permission of content creators. This digital abundance of data and the way it was distributed over internet, was always an issue for content creators, as their work can be copied and shared without approval and remuneration.

The economic theory of the propriety [6] of being scarce is what makes any good valuable. Precious metals are the perfect representation of the concept of scarcity in the real world, as the scarcer a good is perceived to be, the more valuable is accepted to be.

Utilizing the underlying properties of blockchain technology, the internet of assets is reshaping the value chains especially in the Art and Content Creation sectors. This industry has been struggling for a very long time, based on the fact that any type of data that is presented over the internet, can be copied and manipulated, with very few options of monetizing structures. The notion of scarcity within the digital realm is extremely hard to implement. In this context, creating viable business models especially for digital artists was cumbersome, as

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the concept of ownership in such an environment is hard to achieve.

We believe that this is about to change with the evolution of NFTs and the bridge to digital scarcity. An ecosystem evolving around the notions of digital scarcity and ownership [6] will provide new ways to create, authenticate, track, sell and buy any form of art piece.

A very important property for this type of concept is that the creator of an NFT gets to decide the scarcity of their asset. Using blockchain, the issuance of a virtual good can be limited as well as scheduled over a particular time frame.

V. Royalties

For professional artists, NFTs have opened the opportunity to be engaged in a new digital environment from which they can greatly benefit.

One powerful concept that caught a lot of attention is the programmable property of a NFT to pay out royalties [11] to their creator whenever it is sold to a new owner. The process is done automatically and the artwork creator can now benefit and earn royalties whenever a transaction with their artwork is completed.

NFTs contain highly trustworthy documentation of their history and origin and, one important feature coded within the metadata via smart contract, ensures that the original creator receives royalties from secondary sale of the artwork.

A new creator economy is rising and taking advantage of the fact that creators have to possibility to restrict ownership of their content to the platforms they use to publish or get exposure. This mindset is getting a lot of traction, as ownership rights can now be embedded into the content itself.

This new digital system of royalties is very powerful in essence and it guarantees an automatic process of funds distribution for every new sale transaction. A percentage fee of that transaction will be remitted instantaneous to the creator's address which is coded in the token's metadata and this process cannot be modified.

VI. From Tokenization to Monetization

Having in mind a real value proposition, real estate was one of the first concepts that was considered optimal to be tokenized. Decentraland is a virtual reality game that took real-estate to a new level [7]. Decentraland lets you buy NFTs representing virtual parcels of land that you can use as you see fit within the game.

The tokenization of physical items has not reached yet the development stage of similar digital counterparts and this is due to the fact that the real-world deed structures are very complex with a lot of entities acting as intermediaries for validation and ownership purposes.

Great interest has been devoted to this concept and there are various projects which are exploring tokenization processes for real-estate, limited fashion items and many more.

Game developers understood very fast the potential of NFTs, as it can provide records of ownership for in-game items and more importantly it can fuel in-game economies with great benefits for the players and other participants.

Most of the games available in the market today are usually working in a very centralized manner, meaning that most of the features or items you can buy in that game are controlled and managed within that environment only. NFTs are opening a new frontier of secondary markets from which all game participants can transact services, features and in-game items. Game developers are adapting to this new trend and new marketplaces are being developed, expanding the gaming industry horizons.

VII. NFTs and DeFi

Acknowledging that NFTs are value-based assets, a direct relationship can be identified between NFTs and Decentralized Finance (DeFi) [1]. DeFi has evolved around the concepts of borrowing and lending, with a vast majority of lending protocols fueling liquidity into novel decentralized projects.

One of the most interesting ideas is to use NFTs as collateral within these protocols [2] , as it can be treated just as another asset into the portfolio. This means that you can supply an NFT representing a piece of art, media, music or even a tokenized real estate, as collateral, and borrow stablecoins [5] against it.

In order to clearly explain such a process, let's explain and illustrate a DeFi loan:

- Let's imagine that John has 100 ETH which is worth $300,000 (1 ETH = $3,000);
- John wants to buy some items from Eva for a new business model, but he doesn't want to use ETH for this transaction as the value of ETH can increase and he wants to capitalize on the upside potential;
- To secure the transaction he uses a DeFi protocol to take a loan worth $150,000 in the stablecoin DAI (1 DAI = $1);
- The DeFi Protocol offers 50% Loan-to-Value (LTV);
- Based on the way the protocol works, John has over-collateralized the loan, that means he locked ETH worth $300,000 for the value of $150,000 in DAI, as collateral. This process is designed to safeguard against volatility, as ETH's price can increase and decrease, but DAI's price will remain equal to $1;
- John can pay now $150,000 as DAI to Eva for the items he wanted;
- Once he completed his business, John can return the $150,000 worth of DAI (plus interest) to the DeFi protocol, so he can retrieve his ETH;
- In this way John has bought the items from Eva in order to complete his business and keeps his ETH, along with its future upside potential.

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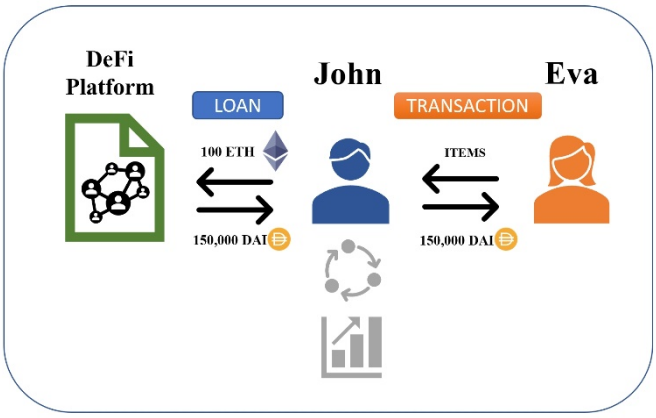

Fig. 1 DeFi Loans

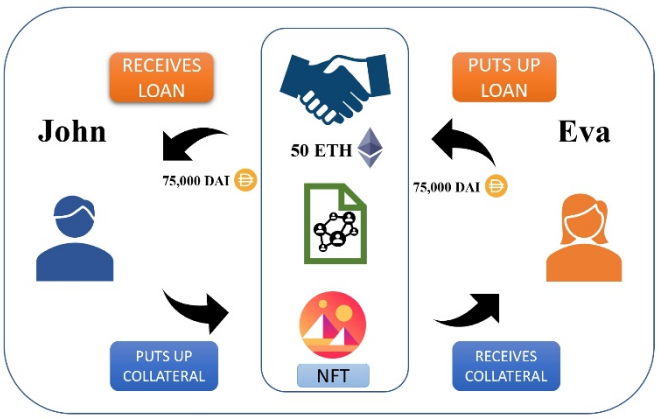

Fig. 2 DeFi – NFT Collateral

In such a structure, the pricing method of NFTs is not straightforward, as they cannot be easily priced for a financial function like the pricing of a loan.

In this concept a problem that was identified is that the value of supplied collateral can be measured by integrating price oracles, which aggregate prices from multiple liquid sources such as centralized and decentralized exchanges. When it comes to NFTs, the markets for such particular concepts are often illiquid, which makes the price discovery process difficult to be mitigate.

A solution for the price discovery in such a situation is subjective to the buyer. New marketplaces, which act as secondary markets for this type of concepts, are developed. In the context of a marketplace for NFT collateralized loans, the lender is the entity who determines the value of the NFT.

A platform that allows this operability is "nftfi" on the Ethereum blockchain [13]. They allow lenders to offer loans, and borrowers to offer NFTs as collateral. The concept works as follows:

- Let's imagine that John owns an in-game asset from Decentraland [7] worth 50 ETH. This NFT is valued at $150,000 based on the value of $3,000/ETH;
- John wants to engage a loan on nftfi.com worth $75,000 and he puts his Decentraland NFT as collateral;
- He takes in consideration a 50% Loan-to-Value (LTV);
- Eva sees the opportunity, acknowledges the value of John's NFT and agrees to lend out 75,000 DAI to John (1 DAI = $1);
- The NFT is locked in a smart contract;
- Once the loan is repaid, the asset will be transferred back to John, otherwise, if payment is not fulfilled in full and due time, based on the auto-execution of the smart contract, the asset will be transferred to Eva.

VIII. Fractional Ownership

An experimental concept is getting some traction focusing on fractionalizing NFTs, which are called "shards" [14]. This gives investors the opportunity to access high value assets by owning a part of that specific NFT. This concept allows more room to play for the participants who do not have the means to buy the whole NFT and enhances liquidity for NFT minters and collectors.

Fractionalized NFTs can be traded on different decentralized exchanges, opening up the space to a larger pool of users. The price discovery structure in such a context can be defined by the price of all its fractions for that specific NFT.

This experimental innovation would unlock the possibility to own a piece of real-world high value assets like a Picasso painting. In this experiment "shards" can be accounted like "shares", so clearly they will fall under a regulatory framework, but the vision of such a concept can entitle shard owners to specific rights in a given structure. We can go further with this vision and think of Decentralized Autonomous Organization (DAO) [20] for managing these assets.

The main features for the shards concept are:

- It can improve liquidity by accessing other open markets;
- Greater exposure and better valuations options;
- Invite stakeholders in new decentralized governance structures [17];
- Allows access to high value assets with low price thresholds;
- Low-cost fee structures and greater diversification.

IX. Conclusions

The concept of Non-Fungible Tokens is empowering artists and content creators, giving them the most needed tools to have control over their artworks in a digital era. Only by implementing this novel innovation model they can control scarcity, avoid counterfeiting, enjoy copyright protection and create new revenue streams.

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The biggest use of NFTs today is in the digital content realm. That's because the industry has been greatly disrupted by the digitization movement and sectors like film and music suffered from replication and piracy issues. Music and film piracy, inflict costs of billions each year to the industry, as easily accessible illegal movie streaming services have become popular for many of the online participants.

We believe that NFTs can truly revolutionize the world of ownership and will reshape different industries like gaming, media and arts.

The benefits provided by this innovation architecture within the sphere of digital assets, is enabling and allowing all artists across the industry, to be introduced to a global audience, where they are able to sell their artwork without the need of any other intermediaries. This main feature is giving the opportunity for a fair distribution of profits especially to the artist or creator of the artwork, as the process of selling and buying is simplified.

Another important feature that can be implemented is a royalty system, which can be programmed into the digital artwork, so that a percentage of the sale profits or fees are redirected to the original creator or artist, for every transaction of their artwork. With this ability, royalties are to be fairly shared each time an artist's artwork is sold to a new owner.

DeFi along with artists and musicians can leverage and accelerate the progress of NFTs as a powerful tool.

NFTs will start having wide appeal in applications that have real world utility. More sustainable use cases for NFTs are being developed and we can enumerate: the purchase of domain names, collateral in decentralized crypto assets loans or registration of deeds for houses or cars. The concept of membership can be integrated with NFTs, that grant the members specific rights within any particular ecosystem.

Like most of the assets, supply and demand are the key market drivers for price discovery. Due to the scarce nature of NFTs and the high demand from gamers, collectors and investors, people are often prepared to pay a lot of money for them.

It remains to be seen how fast NFTs can get beyond the hype that we are experiencing today.

The focus is directed towards scalability and interoperability associated with ERC-721, the dominant, Ethereum-based NFT standard, and on whether the world will embrace outside-the-box ideas for redefining value, ownership and distribution.

NFTs are still in an early stage of development and acknowledgement, but the evolution and adoption of this concept may be the fastest cycle we have encountered so far, for any digital asset. Their utility will increase as digital experiences are built around them, including marketplaces, social networks, showcases, games, and virtual worlds.

We are envisioning new internet communities that in the near future will have their own micro-economies which are fueled and managed in a decentralized manner with fungible and non-fungible tokens that users can use, own, collect and manage.

It's also likely that new consumer-facing crypto products will emerge that can pair with NFTs building new viable business models.

Accelerated by the COVID-19 pandemic, the digital transformation is turning to be one of the biggest opportunity for digital assets adoption. It is an open field for innovation and this environment keeps on surprising by breaking new boundaries with an evolution speed rarely seen in any other industry.

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