Tokenfication - The potential of non-fungible tokens (NFT) for game development

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ABSTRACT

In recent years, there has been an increase in the interest in non-fungible tokens (NFT) to purchase digital art and has shaped a new form of art collecting. The art community has a long history of challenges and opportunities with the commercialization of art. More recently, there has also been an interest in the purchase of game art as investments or collecting. With the advent of blockchain currencies, NFTs have introduced a way for investors, collectors, and game developers to purchase or sell game art. However, the potential of NFT for the games and game development industry is manifold. In this paper, the authors will reflect on the potential of NTF's for game developers and content creators.

CCS CONCEPTS

• **General and reference** → *General literature*; • **Software and its engineering** → **Software system models**.

KEYWORDS

blockchain, games, art, non-fungible token

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1 INTRODUCTION

The use of blockchain technologies to create tokens has created opportunities for game developers, investors, and content creators. With newspaper articles such as the one in the New York Times [52] citing a multi-million dollar sale of digital art with Non-Fungible Tokens (NFTs), the interest in using blockchain technologies for selling and buying digital products is increasing.

The initial development of a blockchain to protect provenance, ownership, distribution, and control of artworks was created in 2014 by Kevin McCoy and Anil Dash [15]. The intention of this technology was to give artists a tool to exercise control over their work, to facilitate the process of commercializing it, and to protect against others appropriating it without permission [15]. Due to the limitations of blockchains, it is not possible to store a digital version of an artwork in a blockchain. The blockchain includes a link to the work. The link either points to a URL or an InterPlanetary File System (IPFS) hash. In most circumstances, it references an IPFS gateway on the Internet run by the organization that sold the NFT.

Tokens have been used as a form of currency for many years. Early on, tokens have been used to pay for goods and are still used in casinos, video game arcades, to pay for public transport, and shopping cart rentals. The use of digital tokens based on blockchain technologies has created considerable opportunities and challenges for the art and game development community.

The art world is no stranger to the potential challenges and opportunities in the commercialization of art. The art community has long debated the challenges of the commercialization of art. There are those that argue that art should not be limited to the domain of wealthy investors or museums, but art should be able (and available) to be enjoyed by everyone. On the other side, some argue that artists should make a living for their craft.

As digital art can be so easily replicated, it is difficult to identify authenticity. For example, the business of collecting signatures of famous people is rife with counterfeits. In several cases, the creator of the signatures has provided free authenticity services. Mark Hamill, for example, verifies his autograph through his Twitter account. However, given how easy it is to copy an authentic signature and copy it onto a non-autographed piece of art, it is possible that even the original author can't identify these fakes.

In video games, the value of digital game objects is becoming increasingly more relevant, and the interest to collect game objects is multifaceted. Livingston et al. [32] explore in their work different types of value that in-game characters provide to players. They define utility, investment, communication, memory, enjoyment, representation of relationships, new experience, creativity, sociability, and self-expression as types of value for game characters. This work has been used by Tondello et al. as a basis to better understand the value of digital game objects [55]. In their study, they noticed an association between the game genre and the different reasons. They also found that utility, enjoyment, investment, self-expression, and memory are the most frequent reasons for valuing digital game objects. Especially for reasons such as investment or collecting, ways to verify the authenticity of digital game objects are becoming increasingly relevant. As a result, we should take a closer look at the potential, in this work, we want to open the discussion on the potential of blockchain technologies for digital game objects and game development.

2 BLOCKCHAIN

According to [59], *"blockchains are tamper-evident and tamper digital ledgers implemented in a distributed fashion and usually without a central authority."* Blockchains facilitate transactions via a shared ledger within that community.

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The benefits of blockchain technologies are decentralized, transparent, open-source, immutable, and provide anonymity [31]. The challenges of blockchain technologies are scalability, interoperability, consume considerable amounts of energy, lack standardization, and lack of regulation [31, 48, 60].

Cryptocurrencies like Bitcoin are fungible. That is, any (bit)coin is equivalent to any other (bit)coin (just like currency). However, unlike Bitcoin, non-fungible tokens are unique to each other. Initially, based on the Ethereum blockchain standard, NFTs have been created for digital art, games, trading cards, or virtual land (see https://nonfungible.com/ for examples).

2.1 Proof of Work (POW) or Proof of Stake (PoS).

Proof of Work (PoW) is a system that requires a significant but feasible computational effort that has been expended for some purpose [38] and prevents double-spends [22]. A double spend is where the same funds are being spent more than once [40]. Currencies like Bitcoin and Ethereum can be processed in a peer-to-peer network securely without the need for verification by a third party. However, due to the way PoW currencies work, they use considerable amounts of power, leading to a significant carbon footprint [41, 56]. With the current standard, a single transaction requires a lot of resources.

An alternative system is Proof of Stake (PoS). With the PoS, a set of nodes stake their own cryptocurrencies for the transaction validation. The benefit of the PoS algorithm is that the network already exists, there is no need for mining, and the need to solve a complex cyrptographic puzzle is eliminated [45]. As a result, this standard can be described as more environmentally friendly.

2.2 The Ethereum Blockchain

To address the challenge of the scalability of blockchains, the Ethereum blockchain was created [58]. The Ethereum blockchain was based on a decentralized system and potentially reducing the amount of time to verify [20, 45].

In 2013, Vitalik Buterin conceived the Ethereum network as a fully decentralized, public blockchain [12]. The Ethereum project was launched on July 30, 2015 [54]. Unlike the Bitcoin blockchain code, which provides a set of established operations, Ethereum is considered as a platform and a programming language running on a blockchain [53, 58].

The Ethereum Request for Comments (ERC) provides application-level standards for developers to recommend a change or token standard to refine and develop the software protocol. The ERC-20 standard lists the minimum instructions to create a token consistent with the general class of identical tokens (they are fungible). ERC-721 describes and defines tokens, where each token is distinct (aka non-fungible) and enables the tracking of distinguishable assets. According to ERC-271, each asset must have its ownership individually and atomically tracked. The ERC-1155 standard allows for the management of any combination of fungible and non-fungible tokens in a single contract, including transferring multiple token types at once [16].

Alternative blockchains used for NFTs include the Tezos Blockchain [6] and the Flow Blockchain [6] and the Flow Blockchain [5]. The Tezos Blockchain provides a peer-to-peer layer that ensures connectivity with other nodes and then passes the received messages to another layer that addresses this network as a distributed database [6]. The Flow Blockchain was initially developed to address some Ethereum Blockchain limitations, which was caused by the volume of trading of CryptoKitties [14].

2.3 Smart Contract

Smart contracts are computer protocols intended to facilitate, verify, or enforce the negotiation or performance of a contract [33, 57]. Szabo [50] defined smart contracts as *"a set of promises, including protocols within which the parties perform on the other promises. The protocols are usually implemented with programs on a computer network or in other forms of digital electronics, therefore these contracts are "smarter" than their paper-based ancestors. No use of artificial intelligence is implied"*. NFTs are classified as smart contracts due to how the Blockchain standard is implemented [33].

3 THE POTENTIAL FOR GAMES

In games and game-related industries, the ownership of digital items becomes increasingly essential. This is confirmed by the results by Livingstone et al. [32] who, describe that digital objects have different values to players such as *utility, investment, communication, memory, enjoyment, representation of relationships, new experience, creativity, sociability, and self-expression*. One major benefit of providing incentives in games is to motivate the player [10, 11]. The intrinsic or extrinsic rewards have been shown to motivate the player to play the game for longer and to play the game in the future [10, 43]. Scholten et al. [46] posit that cryptocurrencies like the Ethereum blockchain have enormous potential to keep players engaged in playing games. Komiya and Nakajima [28] proposed a possible blockchain to motivate the player through achievements. Use cases include collecting and distributing rare in-game items, collectibles, objects created by users, gifts, or signed items by eSport players or streamers. The following sections, introduce and discuss relevant use cases for tokenfication (defined by the authors as *the introduction and use of NFTs to represent digital assets*), especially for game developers.

3.1 Tokenfication

The authors describe Tokenfication as the introduction and use of NFTs to represent digital assets. In this paper, the authors focus on the tokenfication of game assets. We suggest that by creating the verb into a noun, the term describes the multiple uses (and misuse) of tokens in games.

3.2 Crypto-assets and Collectibles

The practice of collecting physical objects for fun includes nostalgia, connection to a historical period or point in time, prestige, or profit is not new [35]. While many individuals have collected digital assets for some time, NFTs have enabled the collection and trading of these items.

In Massively Multiplayer Online Role-Playing Games (MMORPG), players acquire in-game assets (or loot) as a result of gameplay, successful quests, or by purchasing them from within (or outside) the in-game store [17, 24, 26]. This system provides an opportunity for

players from countries like China and Mexico with good Internet access and lower costs of living to play these games full time and sell the in-game assets (gold or loot) on commercial trading sites like eBay [26]. While game developers eventually put in place systems to try to stop these transactions, the practice of collecting and selling in-game assets (gold farming) continues [7].

Potential use cases for game developers include integrating unique rewards to players or groups, in-game artworks, or collectible items.

3.3 Consumer-created Content

Since the introduction of game engines like id Software's Doom Editor Utility in 1993 [21, 29], players have been created or modified (mod) video games. Modifications (mods) like Half-Life and mods of mods like Counter-Strike have seen considerable commercial success [29]. While Half-Life was a commercial enterprise, mods created by the user community for fun (see Team Fortress, for example) have also experienced considerable success [30]. While the developers of the first version of Team Fortress (what is now known as Team Fortress Classic) were offered employment at Valve [30], many other fan-created mods have not done some well. However, the mods have "helped the creator of the editor by extending the shelf-life of the game" ([30] quoting Gabe Newall). The developer of the game editors and game engines have benefited enormously from allowing fans to create mods. Kline et al. [27] posit that involving the customer in the production process builds brand loyalty and "closes the loop" between corporations and consumers. However, although some consumers have benefited from their labor, so have the corporations. Many of these consumers create mods for fun or recognition (fame) and not for commercial rewards. The concept of volunteer labor that benefits a corporation has been referred to as *playbour* [23, 29]. Modders are typically players of a particular game or genre and buy the game engine to make their own version or vision of the game. Even if this modded game is not a commercial success, the companies that develop and sell the game engines still benefit from the sale of the game engine and the reputation of being supportive of the modding community [44]. However, the process of big business benefiting from the free (or lowly paid) labor of fans is not without its critics. Goggin [23] refers to the process as the commodification of fan artwork and creativity. In 2018 Takahashi [51] talked about a Leisure Economy as a "*utopia where people can make a living by getting paid to play games.*" At the time this may have raised a few eyebrows (in disbelief), the number of Twitch and YouTube streamers who are getting paid a respectable income may provide some guidance of the potential for the games industry. This Leisure Economy appears to be an oxymoron, should leisure be commodified? If we look at Social Media platforms like Facebook, the developer is benefiting from user-created content.

While many game developers claim ownership of player-created content that uses the developer's tools or intellectual property, some developers like Valve share the proceeds from selling user-created content ([30]). In many cases, the corporation tends to do much better than the person who created the content. Valve has a history of benefiting from players creating in-game content [8]. In 2014, Aziz [8] reported that Valve had paid over $10,000,000 to 661 content creators. In only a year, this number had more than quintupled to $57,000,000 [36]. Given that Valve shares a percentage of the revenue from the sale of the user-created in-game content, this appears to be a very good business model for Valve. However, if we use a tool like Photoshop to create an original image, Adobe has no rights to any royalties from the sale of this image. How is this any different from user-created content from a game?

3.4 Blockchain Games

The Ethereum standard has resulted in several game developers creating games that enable the player to create or enable the creation (*breed*) of unique game objects. Some notable examples are CyrptoKitties [4], Axie Infinity [1], and Alien Worlds [2][1].

3.4.1 CryptoKitties. In the case of Cryptokitties [47], the developer managed to create considerable revenue and interest in users creating, breeding, collecting, and selling in-game assets using the Ethereum blockchain (an NFT) [4]. For the user, this model represents an opportunity to own the content they created (Figure 1). The New York Times reported one Cryptokitty selling for $140,000 [34].

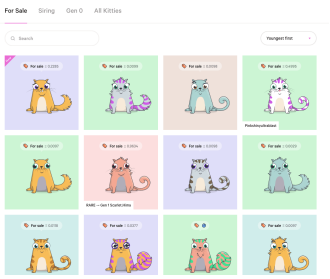

Figure 1: Cryptokitties for Sale. [4]

3.4.2 Axie Infinity. Like CryptoKitties, Axie Infinity enables users to collect, raise, breed, and battle other creatures known as axies [1]. Pokemon-inspired digital pet universe where players use the characters in various games. Unlike CryptoKitties, Axie Infinity also enables players to create game content (land) and sell it. Axie Infinity also uses the Etherium Blockchain standard [1].

3.4.3 Alien Worlds. At the time of writing, Alien Worlds [2] was the top-ranked blockchain game with 22.2K users [3]. Alien Worlds is a user-created world where the player can collect and play with unique digital items [2]. Unlike CryptoKitties, Alien Worlds does not currently facilitate the process of *breeding* game objects.

3.4.4 Yield Guild Games. Another interesting, more recent trend has been the introduction of games that let players earn NFTs while playing the game. Games like Yield Guild[2] facilitate players earning NFTs through gameplay. Games like Yield Guild appear to benefit from and encourage the process of gold mining.

[1] See https://dappradar.com/rankings/category/games for a current and comprehensive list

[2] https://yieldguild.io/

3.4.5 But wait, there's more. The NFT craze has already dramatically impacted the collectible market, and like other sectors that join emerging markets, the games industry is not far behind. When the authors started writing this paper, a few games used NFTs for collection, acquisition, and trading. By the time this paper was submitted for publication, the number of games that used NFTs had more than doubled. A strong upward trend is apparent.

3.5 Proof of Stake in Games

As mentioned above, PoS is an interesting and resource-saving alternative and can add various use cases to the games industry. There are three interesting use cases for PoS in gaming: (1) In-game economies can be supported by PoS currencies. Developers can even tweak the algorithm to balance staking for players. This is not only relevant for one game but the same currency could be used by several games. (2) Transactions fees of other payment methods (for example, credit cards) can be reduced. (3) Users have full control and can use the currency to buy new games.

4 THE CHALLENGES WITH NFTS

While NFTs represent considerable opportunities for artists, collectors, game developers, and users, there are some challenges associated with NFTs that can not be ignored.

4.1 Regulation

One of the main concerns is the lack of regulation or any central bank oversight [18]. Moreover, unlike traditional currencies regulated and controlled by central government regulation, control, and policy, NFTs have no capital value. The market determines the value of an NFT. As these transactions operate outside of central government regulation, there is a risk of people using this to launder money or evade regulatory oversight [61]. Moreover, there is a concern on how NFTs can be taxed [49].

4.2 Power Consumption

One of the major criticisms of the Bitcoin standard was the amount of power consumption needed for validation [41]. One of the key features of the Ethereum standard was to reduce the power consumption needs of other cryptocurrencies like Bitcoin [41, 56]. While the Ethereum standard did help reduce the amount of power consumption when compared to Bitcoin [9], the process of verification still requires considerable amounts of power [13]. The power consumption of cryptocurrencies has raised concerns about the impact on global warming [39]. Although the majority of concern has been focused on Bitcoin, NFT's also consume considerable power [19]. The introduction of POS encryption may address some of these concerns [45].

4.3 Security

Another concern about NFTs is that if the company that issued the NFT goes out of business, is hacked, or stops hosting the file, and the buyer will be left with a token that points to a file that no longer exists. Moreover, if someone hacks or steals the buyer's computer where the token is held, they will lose it. The increase in the number of hackers stealing personal data from corporate or government databases is of considerable concern [42]. Given the perceived value of some NFTs, it is only a matter of time before hackers start trying to infiltrate the servers that host the token. This could result in hackers holding the token for ransom or selling it to someone else. As the token is held by the consumer and the host server, this puts considerable pressure on the security of the NFT.

4.4 Blockchain Risk

Blockchains, like Ethereum, have proven to be relatively robust. However, there is some concern that there could be a bug in the code that breaks down how Ethereum is supposed to function. An example of the potential for hackers to exploit the vulnerabilities of the Ethereum blockchain was when Within days of its launch, the DAO was exploited and drained of nearly 3.7m Ethereum tokens [18, 37].

4.5 Marginalized Communities

Another potential challenge for NFTs is that as they primarily support the exchange of digital assets, there is a risk of marginalizing the arts community whose creative practice is not well suited to a digital format. Moreover, if the NFT is a digital reproduction of a physical object, who owns the property rights of the original?

4.6 Ownership & Intellectual Property Rights

The actual owner of consumer-developed digital content is an ambiguous legal concept. While it has been possible to copyright computer software, the idea owning a digital property that the consumer made is fraught with challenges. If a consumer in France creates a digital asset using software owned by a company in the USA and the software is hosted in China, which laws would apply? The laws of France (the residence of the person who made it), the USA (the country of residence of the software company), or China, where the software is hosted?.

The other legal challenge is around digital reproductions of physical objects. An NFT of a digital photo of a physical object provides a trace of the owner of the digital photo, there is no record of who owns the copyright of the physical object. Further, the creation of memes or other community created content, usually involves a combination of art that belongs to someone. Further, creating memes or other community-created content usually involves a combination of art that belongs to someone (who hold the Intellectual Property Rights (IPR)) and text that the user created.

Another legal challenge is around who has the right to copy the digital work. While developers like Valve provide guidance in the end user license agreement (EULA) as to the right to copy and commercial use, there does not appear to be a lot of guidance on who is the copyright holder for an NFT of digital content. Further, the consumer has an NFT of a digital asset is held on the server, what is there to stop the anyone from copying, making a minor change to the content, and then selling an NFT for the changed version? Moreover, in games where players *breed* game objects if player A's game object and Player B's game object create a new game object, which player owns the intellectual property, and who would benefit from selling the child game object? If the *child* game object then breeds with player C's game object, who would own the IPR of the grandchild?

4.7 Currency

At the time of writing, there were multiple Blockchains used for buying and selling game content (see [3]). While many of these Blockchains are based on the Ethereum standard, none of them can be easily exchanged without an intermediary. Moreover, only a few of them can be exchanged with an intermediary. While this might be fine for players within a game, it makes it challenging to exchange ownership of items from different games or gaming platforms. There is no central system for determining the exchange rate or providing oversight of these transactions, this adds an element of risk for players wanting to exchange, for example, a CryptoKitty with an Axie.

Another issue with Blockchain currencies is the lack of standardization. While Ethereum established a standard, other developers identified some challenges with this standard and developed their own. As noted, Flow was created to reduce the power consumption used in the Ethereum blockchain [5]. EOSIO is another blockchain developed to address the power consumption challenges associated with the Ethereum blockchain [25]. However, while addressing the limitations of the Ethereum blockchain, the EOSIO blockchain is open to more security risks [25]. As creating a blockchain is not especially challenging, it is highly likely that there will be many more standards used for NFTs.

4.8 Exchange

With physical money, there is a system of exchanging one currency for another. However, with Cryptocurrencies, exchanging one cryptocurrency for another becomes more challenging. While it is relatively easy to purchase cryptocurrencies, exchanging them for cash is more challenging.

5 CONCLUSION

In this paper, the authors provided an overview of NFTs. The authors have also provided an overview of some challenges and opportunities for game developers planning to use NFTs. While there is a potentially enormous opportunity for developers to leverage NFTs to enable players and investors to buy and sell in-game content, there is conversely an enormous risk. While the use of NFTs in games is still emerging, it will be interesting to see if major corporations and or governments take a position to standardize and regulate this industry. Until then, it's a bit like living in the Wild West.

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