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A Token Gesture: Non-Transferable NFTs, Digital Possessions and Ownership Design

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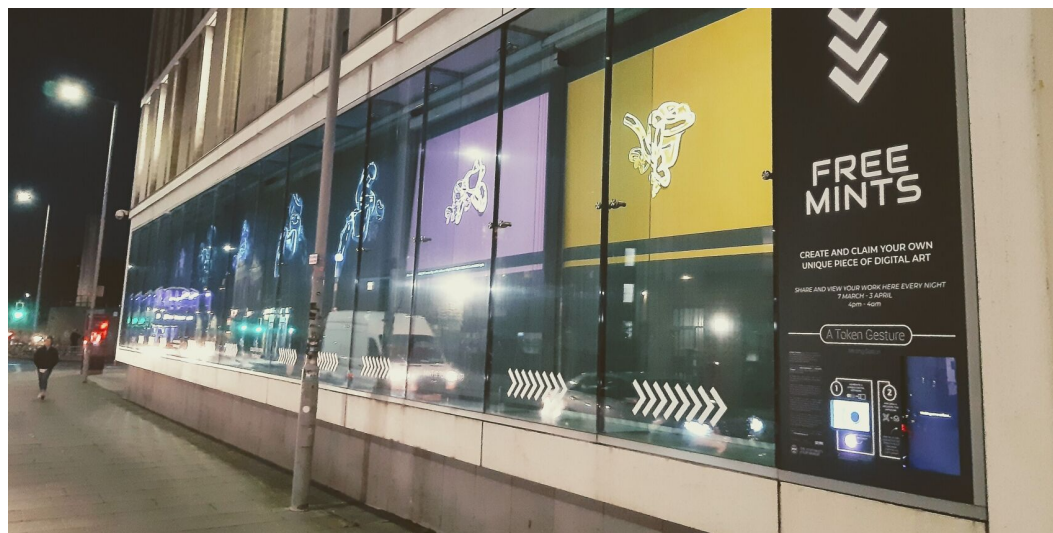


Fig. 1. A photo of the *A Token Gesture* exhibit, showing the capture kiosk, and City Screens.

This paper presents the design, deployment and qualitative study of a large-scale, public, generative art exhibition, through which passers-by could create artworks, and mint a non-fungible-token (NFT). Following the month-long exhibition, during which 229 anonymous participants produced artworks, 69 non-transferable NFTs were minted, we surveyed (33) and interviewed (14) expert and novice participants about their experiences. We explored contemporary challenges of owning digital things, and the extent to which NFTs, and ‘Web3’ technologies offer meaningful forms of ownership. Our findings describe how the inability to trade this NFT, and its unique circumstances of acquisition, made it meaningful in ways that extended beyond its immediate (limited) utility and offered participants something through which to construct identity. Reflecting on the aspirations, contradictions, and misconceptions of forms of ownership enabled by NFTs, we conclude with

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proposals for renewed attention in HCI to the nature of digital possessions, and the potential for ‘ownership design’.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing systems and tools**.

Additional Key Words and Phrases: NFTs, Non-Transferable, Ownership, Digital Possessions, Blockchain, Generative Art, Web3, Public Experiences

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1 INTRODUCTION

The most recent market bubble and hype cycle for blockchains and cryptocurrencies in 2021 was led in particular by markets for Non-Fungible Tokens (NFTs) and more broadly, enthusiasm for the concept of a more decentralized internet, referred to as ‘Web3’ [63]. These trends are underpinned by ambitions to demonstrate applications of blockchain technologies that go beyond speculative financial trading, and rather, provide means for individuals and communities to better co-ordinate, possess, control, and own digital things and assets.

In this paper we set out to question and investigate this promise. Specifically, we sought to understand: A) What are the perceived values of NFTs beyond financial trading and exchange? B) How do the novel forms of ownership potentially offered by NFTs relate to and mediate these values? To this end, in spring 2022, we undertook the design, development, and deployment of an exhibition - *A Token Gesture* - through which members of the public could create unique generative artworks and mint a non-transferable NFT linked to the artwork, which was subsequently displayed through street-level projections. This paper describes how the experience exposed and reflected various attitudes, desires, and opinions about the distributed ownership of digital things, and the extent to which NFTs and other decentralized technologies may substantially address questions of ownership.

Significantly, concerns about individual and collaborative ownership of digital things are not new, and have been of longstanding interest to the CSCW and HCI communities. Writing in 2012, Odom et al. offer numerous vignettes that show how the emergence of networked cloud computing complicates experiences of owning and possessing digital things. As one of their participants starkly put it: “*the idea of owning something digital seems lost in translation*” [55, p. 781]. Since then, cloud services have become the default means of storing users’ data, account details, and files, making them accessible across multiple devices simultaneously. Similarly, streaming platforms such as *Netflix* and *Spotify* have usurped traditional possession of physical copies of films and music. Legal scholars Perzanowski & Schultz [62] point to the ‘buy now’ lie as an example of the ‘End of Ownership’, where many digital products – such as an eBook purchased via an *Amazon Kindle* – are in fact simply licensed from, and dependent upon, digital service providers and their ever-changing terms and conditions. Whereas ownership is an *absolute right* that holds against everyone, licences are *contractual rights*, which only hold against the specific platform providing a service. Indeed, these platforms may not even own the media they provide, but rather hold copyright that allows distribution. In these contexts, vast and cheap (but carefully managed and surveilled [85]) access to digital services and media has been prioritized ahead of personal *ownership* of specific products. Beyond concerns about the power, politics, and fragility of these web services, numerous prior studies in HCI [17, 21, 45, 55, 58, 59, 78] have shown that there is more to the experience and meaning of ownership than simply having and managing access.

In 2012, Odom et al. [55] speculated about properties of digital systems that could support a more profound experience of ownership. Their suggestions included: better digital rights and digital identity management solutions (without over-burdening users); files and digital stuff that have greater ‘permanency’ – *“where the stuff itself and the architecture of where it is stored should have demonstrable properties that prohibit or make especially difficult the destruction of them”* [55, p. 789]; retaining a sense of an ‘originating file’ and the ‘life history of an object’; *“allowing shared possession but pointing somehow to the original object”* [55, p. 789]; and the ability to withdraw ownership rights and give up access.

What is striking, writing now in 2023, is the extent to which blockchains and distributed ledger technologies (DLTs) have been promoted as offering several of these qualities. Elsdon et al. [19] offer a more in-depth typology of proposed blockchain applications, but key features include: immutable distributed records and consensus systems that provide a shared accounting system; timestamping and marking of digital transactions and things; a distributed history of all transactions made on a network, including the genesis of data, files, and tokens; and, finally, the issuing (or minting) of unique, non-fungible tokens that create something that is digitally scarce and cannot be copied.

Returning to Odom et al., [55] they summarise that: *“to possess is not merely a noun nor a verb, but a complex set of actions that transform the relationship between a thing (virtual or physical) and a person”* [55, p. 790]. Both the dominance of centralized cloud computing infrastructures and the mainstream interest in NFTs and Web3 technologies, point to an ongoing sense that there remains a considerable deficit of meaningful ownership and possession of digital things and assets. On this footing, we set out to explore the various ways in which decentralization (and specifically NFTs) may or may not offer new provide means to reconfigure experiences of digital ownership.

The critiques of blockchain applications in practice are well documented and include (among others) excessive energy consumption [1], financial exploitation and fraud, with a lack of consumer protections or regulatory mechanisms [70], alongside repeated failures in real-world implementations (e.g. <https://web3isgoinggreat.com/>). There are, of course, varying viewpoints on the extent to which these problems can ever be resolved, socially or technically. Nonetheless, as Murray-Rust et al. [50] have shown, taking a longer-term, academic view of research and design about and through these disruptive technologies can bring new perspectives on longstanding socio-technical challenges - such as digital ownership.

As part of a longer-term project on decentralized economies and ownership, we designed and developed *A Token Gesture*, a month-long public exhibition and series of events, where members of the public in Edinburgh were able to: **(a)** Generate new and unique pieces of digital art through a street-level, walk-up interaction; **(b)** Register their artwork for display in a public, street-facing exhibition via large projection screens and an online gallery; and **(c)** Using the *Tezos* blockchain (<https://tezos.com/>), mint, claim, and own a non-transferable (and hence not available for sale) NFT representing their piece of art.

Through this exhibition we engaged a diverse public audience, including up to 1788 interactions where at least 229 members of the public created an artwork, and the minting of 79 unique NFTs. In contrast to much other research on blockchain technologies, many of these participants had never before engaged with, or owned any cryptocurrencies or NFTs. In this paper, we reflect primarily on both the design and deployment of this exhibition and the findings from a qualitative interview study of participants’ experiences. While open-ended and exploratory, the exhibition allowed us to ask questions about the extent to which NFTs, and associated decentralised technologies, are able to provide new means of digital ownership in particular communities and public spaces, how they might do this, and fundamentally, what participants sought from a greater experience of digital ownership.

There are several contributions of this work, for CSCW and HCI researchers: **1)** We provide a report and design of a novel blockchain-based system, involving the creation of non-transferable (and hence non-financial) NFTs, with a public, interactive, walk-up, user-centric minting process; **2)** We examine diverse public experiences of NFTs, looking beyond expert online communities and financially motivated interactions; **3)** We examine the various ways in which NFTs can potentially become meaningful for people beyond financial speculation; **4)** Through this experience, we offer a contemporary view of how blockchains and Web3 can (and cannot) address longstanding challenges of digital ownership and possessions, specifically as means to independently own and control metadata; and **5)** Call more broadly for HCI researchers to engage with and address the challenges of ‘*Ownership Design*’ in the context of networked technologies.

Finally, in presenting this work at CSCW, we wish to particularly emphasise the social and collaborative aspects of this exhibition and study. Artworks produced by participants were the result of a collaboration with a generative artist. Participants then had opportunities to display their artworks and NFTs with others, in a shared, evolving exhibition of closely related works. We observed participants’ desires to connect to a wider community and sub-culture through participating in the exhibition, and saw how experiences of ownership and authenticity depended upon proving originality to others. Most crucially in this paper, we examine the key role of ‘ownership design’ in mediating collaboration and social relations around digital media and assets.

2 BACKGROUND & RELATED WORK

There is a vast literature, especially in the fields of anthropology, consumer behaviour, and law, that concerns individuals’ experiences of ownership. Anthropologists have a particular focus on material culture and the role and meaning of possessions to individuals and groups, while legal scholarship considers how ownership and property are practically defined, enacted, and enforced. While in everyday language often used synonymously, law tends to distinguish *possession* – archetypically the physical control over an object – from *ownership*, a bundle of rights (such as the right to sell, destroy, use, and exclude others) that can be evoked against everyone, and in this sense is called ‘absolute’. Possession, however, is often strong evidence for ownership [47]. Much of this literature has been touched by prior work in HCI, hence we recover here some key references for our study before examining more fully the literature on digital possessions. Finally, we examine the state of the art of NFTs, and the limited prior research on these technologies, and identify the ways in which NFTs can be considered primarily a technology of ownership.

2.1 Studies of Personal Possessions and Ownership

The meaning that humans attach to their possessions goes far deeper than their immediate utility, and plays an important role in how we distinguish ourselves individually, and signify our social affiliations. Daniel Miller [48] forcefully emphasises the deep, often hidden, meaning behind the many objects people collect, display, and store in their homes, which ultimately come to express their owners. In the field of consumer behaviour, Belk [6] offers extensive examples of the types of things we feel we possess and the impact that possession of them has on our sense of self. Through this synthesis, Belk examines what causes us to feel that we possess something, and how, through the process of acquisition, we come to see it as part of ourselves. From parts of our own body to the cars that we drive and even to other people and places, we may assimilate characteristics of the objects we possess into our own sense of identity. The extent to which we identify with these things can also explain the disruption and despair caused through loss or damage to what we view as ours. Further, Belk suggests that the way an object is originally produced influences its value and meaning. For example, through purchasing an artwork or a limited-edition record, we may feel

affinity with the artist who made it, and gain a feeling of recognition and status or define oneself as a ‘fan’ [28, 36, 66].

Lay understanding and feelings of how or why something can be described as *mine* often also depend on how it is acquired, and inform legal constructions of ownership. Heller & Salzman [35] propose that our instincts for ownership are governed by six hidden rules. Working primarily from a US legal perspective, these rules offer common bases for *legal* definitions of ownership and property, as well as underlying *morals* about how ownership can and should be determined. For example: ‘possession’ – it’s mine because I am currently in possession of it. ‘First-in-time’ rewards those who first find, or make, an ownership claim (this is the basis for an orderly queue for tickets, or indeed the gold rush and colonial expansion). ‘Labour’ describes the sense that ownership is earned or achieved through work – for example, by hunting an animal, or building a sandcastle; this principle also underpins the concepts of copyright and patenting. ‘Attachment’ suggests that one can claim ownership of things that are attached to something else you already own.

It is not the case that any one of these ownership rules is necessarily better, or more important, than the others – nor are they necessarily exclusive. Rather, these rules can be thought of as a series of dials or preferences, which are used throughout everyday life to design and designate ownership. Often, when poorly configured, ambiguous, or misunderstood, these rules can be problematic – leading to exploitation or privileging of certain groups, or incentivizing harmful or unsustainable behaviours. A key focus for our research is how new technologies and interaction design offer new means to manage and configure ownership of digital things via rules such as these.¹

2.2 Digital Possessions and Ownership in HCI and CSCW

Prior research on ownership among HCI and CSCW research, emerged from work on personal information management and digital archiving [42, 44]. At the time, scholars explored how people anxiously sought to manage, bring order to, curate, and draw meaning from digital records of their lives, for example, collections of digital photographs [41], emails and correspondence [76], social media accounts [84], or personal informatics data [18], particularly at key moments of life transition [15]. Other strands of research explored more decentralised ‘personal data stores’ as means to empower users [75], and means to attach data to physical objects as ‘tales of things’ [4]. Whereas initial studies appear to show individuals aiming to maintain and control comprehensive personal archives, later work identified that expedient access to digital things [17] has become valorized ahead of absolute control and ownership. Indeed, in 2013, Harper et al. [34] acknowledged and theorized that the metaphors of owning a file had begun to break down. Elsewhere, Gruning [30, 31] revealed participants’ frustrations that media such as eBooks cannot be treated as individual files to be moved around and shared with others.

Hence, as archives continued to expand, facilitated by networked devices and cloud storage, scholars noted a particular shift where ‘virtual possessions’ were requiring particular practices of care, and had features distinct from traditional material possessions. Drawing on Belk’s concept of possessions as part of an ‘Extended Self’ [6], interviews with American teenagers revealed the extent to which individuals became attached to virtual possessions, and used them as a site of identity work and self-reflection [58]. In a synthesizing paper, Odom et al. [59] went on to describe virtual possessions as uniquely placeless, spaceless, and formless. Odom also discusses how they distinctly accrue metadata that may “*enable participants to craft and keep social histories*” [54, p. 32].

¹The picture is complicated further for digital possessions, since most personal data is not legally defined as something that can be owned, but controlled through various rights - such as copyright or data protection. A recent consultation by the UK Law Commission on digital assets is notably seeking to define data that can be owned, in a legal sense, similar to physical property [60].

Taken together, these studies demonstrate the deep meaning and value of digital possessions – of various forms – and the persistent challenges to manage, preserve, and control them. In a digital context, having access has become synonymous with possession and ownership, though expectations have grown for digital platforms to provide means for individuals to control their content – for example, to remove, hide, protect, or preserve it [9, 45]. For a personal archive, an address book, or a commercial social media account – the desired tools, control, and explicit extent of ownership may differ. In the context of gaming especially, the labour to acquire, and the subsequent utility of, specific in-game assets evokes deep connections to virtual goods [3, 51, 68]. As the ‘End of Ownership’ illustrates [62] – these arrangements currently depend upon the terms of software license agreements. There hence exists a trade-off between having greater ownership and control over one’s digital possessions, and the responsibility, cost, and work of preserving and maintaining access to them [41, 42].

Yet, while there is continued momentum around the subjects of privacy and control of our online content [61, 82, 83], the value and meaning that arises from the experience of ownership has arguably been overlooked in recent years. In this context, the emergence and promise of technologies such as blockchains and NFTs, towards more direct means of owning and exchanging digital things, offers imaginaries for new models of digital ownership beyond the paradigm of cloud computing.

2.3 NFTs as Ownership Technologies

Forms of non-fungible tokens (NFTs) have existed and been conceptualised since 2012, first based on the *Bitcoin* blockchain, and described as ‘coloured coins’ where “*by carefully tracking the origin of a given bitcoin, it is possible to color a set of coins to distinguish it from the rest*” [65]. It was realised that coloured coins could be attached to other existing assets, such as certificates, financial instruments, artworks, or property deeds. These coins or tokens, which are demonstrably unique and scarce, and cannot be copied, could then be used as a decentralized means to record and exchange ownership of these assets. This idea did not gain mainstream success at the time. However, through several other experiments – such as blockchain-based ‘monetized graphics’ where a video clip was registered and sold via the *Namecoin* blockchain [14] – by January 2018 a proposal was made to the *Ethereum* blockchain for a ‘token standard’ to support the development of NFTs. This standard – ERC-721 – was a catalyst for the crypto art movement. Along with the emergence of NFT marketplaces such as *OpenSea* and *Objkt*, these standards set the stage for NFTs to lead a crypto-market bubble and become a mainstream technological phenomenon, with NFTs such as ‘Beeple’s First 5000 Days’ selling at a Christies auction for \$69m. Baytaş et al. [5] describe the relationships of stakeholders in the NFT ecosystem, from independent artists, creators, owners, and developers through to large corporations and auction houses. Many well-known ‘profile pic’ NFTs share a particular cartoon-esque aesthetic (most notably the top value NFT collection ‘Bored Ape Yacht Club’). However, NFTs can be linked to any form of digital media, including generative and geometric artworks, photography collections, music, and game items [52].

NFTs have had a degree of academic attention since 2021, though often limited to specific disciplinary perspectives – financial, technological, and legal – with few studies of the social meaning and experiences of NFT ownership. Financial scholars have studied the nature of NFT marketplaces [2, 38, 52, 80], while critics have pointed to their potential social inequity [53]. Technologists aim to understand how NFT ecosystems operate [11, 77] or propose new platforms [40, 64] and standards [10]. Legal scholars have, for the most part, grappled with the challenges that NFTs bring to copyright [7, 22, 25, 32, 43, 69, 86]. A recent industry report [72] has described how misconceptions around copyright and NFT artworks are rife, with many high-value projects retaining copyright, and granting token-holders only access and (often very limited) usage rights

– a situation that largely mirrors existing end-user licence agreements. Research on the NFT marketplaces for digital art has interrogated the consequences for notions of authenticity [26], commodification [37], and rarity [46]. Such questions demonstrate the potential to use NFTs to explore concepts of ownership, possession, and identity.

The relative scarcity of human-centred work on NFTs accords with Froehlich et al.’s survey of blockchain and cryptocurrency work in HCI and their expectation of “*more work around the category of ownership and possession in the near future*” [24, p. 167]. In this vein, our research extends prior work by looking beyond the nature of NFTs as speculative financial vehicles, or mechanisms to assign copyright, and instead towards understanding the ways in which individuals find NFTs meaningful, and in particular, how they may offer valued experiences of ownership.

3 METHODOLOGICAL APPROACH

Taking place as part of a longer-term research project about decentralized creative economies, we sought to investigate the promise of NFTs as an ownership technology and infrastructure through a practical, situated, and design-led study. In particular, we wanted to offer an accessible, ‘in-the-wild’ [12], public experience of these emerging technologies to engage a broad (and often sceptical) audience – in addition to those already invested in and engaging with crypto-economies. Through this experience, we sought to ground the extreme hyperbole and criticism of blockchains, and develop our own hands-on experience of working with non-fungible tokens and the codebase, protocols and decentralised infrastructure that enable them. In this sense, this project is an example of ‘Research through Design’ [23, 27] – where we sought to learn iteratively, through our practice – underpinned by a core research focus on how experiences of digital ownership can be mediated through NFTs.

In this approach, we have been inspired by previous projects that engage publics with blockchain technologies at varied degrees of fidelity, and in particular the framing offered by Murray-Rust et al. [50], where such deployments expose and highlight different aspects of the technology, as well as surfacing diverse socio-technical imaginaries. Crucially, a design-led approach allows researchers to construct a space where diverse participants can explore, experiment with, and envision various applications of a technology, in ways that otherwise may not exist, or be accessible to study. Specifically in our case – we enabled novice users to engage meaningfully with these technologies; and presented a highly novel experience of NFTs that were non-transferable and hence non-financial. Our aim was therefore to look beyond the narrow application of these technologies as they are now, and to consider the longer-term possibilities, desires, and challenges they offer.

Furthermore, we would describe the system and exhibition as a form of ‘Research Product’ [56] (rather than simply a prototype), which was designed to *fit* a specific environment, could *function* independently for a prolonged period, had a high level of *finish* and was *inquiry-driven*, with a focus on understanding new experiences and utility of owning a (non-transferable) NFT. The deployment of research products allow for longer term, and situated research grounded in diverse, real-world experiences and contexts. We view this kind of grounding and unpacking as a vital way to understand an otherwise highly complex, unfamiliar, and overhyped technology and infrastructure.

The resulting *A Token Gesture* system and exhibition also provided an opportunity for in-depth empirical study of participants’ experiences. This included reflections on events hosted by the research team, anonymous analytics data captured through interactions with the system, and a more directed, qualitative survey and interview study (described in Section 5). Our open-ended intervention offered and produced many threads for potential inquiry around these beguiling technologies. However, beyond general descriptive questions around users interactions and motivations, our qualitative data collection honed in on questions and experiences of ownership produced through

users' engagement. Likewise, our data analysis (Section 5.6) prioritized discussions of ownership, which are the primary focus of this paper. Importantly, the novel and provocative experience provided through the exhibition, offered participants a platform to discuss digital ownership more broadly, with reference to decentralised and Web3 technologies.

4 A *TOKEN GESTURE* SYSTEM

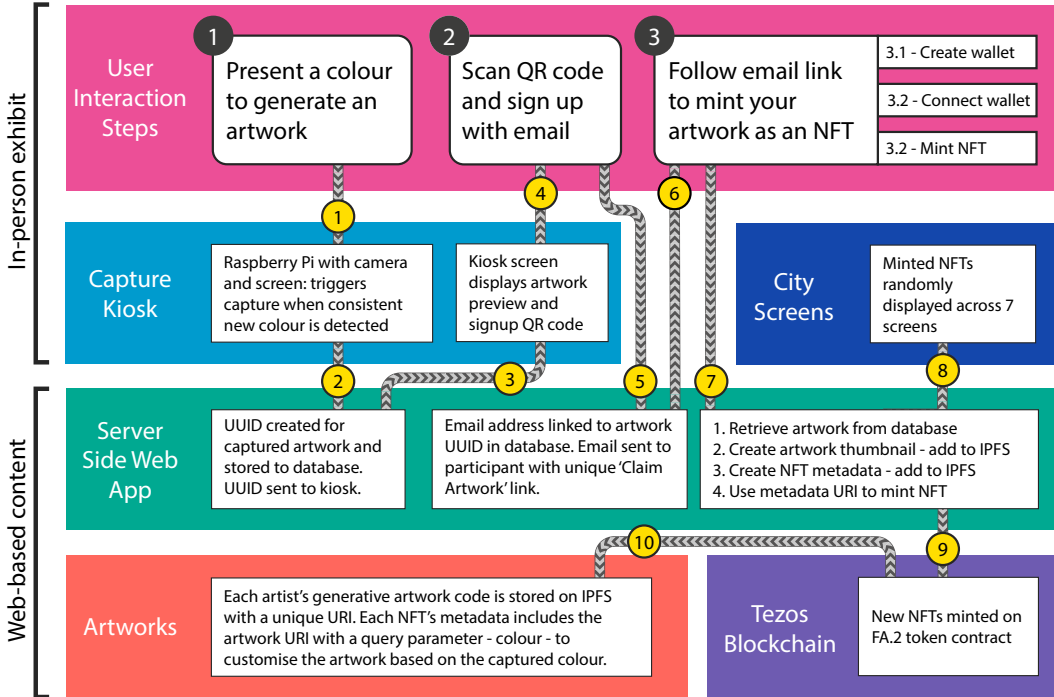


Fig. 2. An illustration of the technical components of the *A Token Gesture* exhibit and the three user interaction steps. The flow of information between components are indicated by the arrowed lines

4.1 *A Token Gesture* : Technical Components

A Token Gesture comprised five key components that interfaced together to create an interactive exhibit. These are shown in Figure 2, and described in more detail below.

- (1) **Capture Kiosk:** The interactive elements of the exhibit were facilitated via the capture kiosk, situated in one of the windows of Inspace . The kiosk featured a web cam, illuminated by an LED ring, which was used for capturing colours via custom software on a Raspberry Pi computer. Above this was a small, 10" screen, which provided instructions and feedback during the colour capture step. To the right of this was a larger, portrait-oriented screen, displaying the kiosk web-page, which, following colour capture, presented a live preview of the artwork and a QR code for signing up to mint an NFT. A vinyl display with cut-outs for the screens and camera was applied to the outside of the window, and this also provided signage, information, and instructions for the exhibition.

- (2) **City Screens:** The City Screens consist of seven rear projection screens, which line the street-facing windows along one side of Inspace . During the *A Token Gesture* exhibition, each screen displayed a random selection of artworks that had been minted as NFTs.
- (3) **Server-Side Web Application:** The main elements of the exhibit were created as a server-side web app, using the Express web framework alongside a PostgreSQL database. The app served public web pages for the project, including the sign-up and NFT minting pages. Private (authenticated) pages and API routes were also included for the kiosk web page and colour capture input. The PostgreSQL database was used to store captured artworks (mintable artwork), minted NFTs, and participant data (email, number of visits to the minting page, number of minted NFTs, and email subscription status). Taquito – a TypeScript library (<https://tezostaquito.io/>) – was used for interactions between the web app and the Tezos blockchain/wallets.
- (4) **Artworks:** The *A Token Gesture* artworks are live, generative artworks that are designed to be viewed in a web browser, and which vary their appearance based on a provided input colour. Two local artists were commissioned and paid to create artworks for *A Token Gesture* . The artists were provided with a boilerplate project, consisting of an html file and associated JavaScript script, which extracts a hexadecimal colour value from a URL query parameter named ‘colour’ and makes it available as a local variable. The final files for each of the two artworks were uploaded to IPFS (<https://ipfs.io/>), a peer-to-peer network and protocol for distributed file storage and sharing. This means that there is a unique IPFS Uniform Resource Identifier (URI) for each artwork, and custom versions of each artwork are generated simply by modifying the colour value in the artwork’s URL.
- (5) **Tezos Smart Contract:** Tezos was chosen as an underlying blockchain platform due to its energy efficient ‘Proof of Stake’ mechanism, and its reputation among generative artists. The smart contract for issuing the NFTs was created using SmartPy – a Python-based smart contract development platform for Tezos. The *A Token Gesture* contract is based on a modified version of the FA.2 template provided by SmartPy, where all token transfers are disabled, meaning that the NFTs created by the contract are non-transferable.

4.2 *A Token Gesture* : User Interaction Steps

Creating a custom *A Token Gesture* artwork and minting it as an NFT involved three stages: **1)** capturing a colour at the in-person exhibit; **2)** signing up using a unique QR code and email address; **3)** following a unique link in an email to mint the artwork as an NFT. These stages are briefly described below.

- (1) **Colour Capture:** Interaction with *A Token Gesture* began when a participant presented a colour to the camera at the Capture Kiosk [Figure 3]. The captured colour was sent to the server-side app and stored in a database whilst the larger kiosk LCD screen updated with a preview of the artwork and a unique QR code.
- (2) **Sign-Up:** The QR code directed the participant to a sign-up page where they were asked to consent to participating in the exhibition before signing up using an email address. The participant’s email address was then stored in a database, their artwork was marked as ‘reserved’ (to avoid others using the same QR code link), and they were sent an email containing a unique link to ‘mint’ their artwork as an NFT.
- (3) **Minting:** When the participant visited the ‘mint’ link in their email, they were taken to the minting page [Figure 4], which presented three steps to mint their artwork: **1)** create a wallet; **2)** connect the wallet; **3)** mint the artwork. The page provided clear instructions for each step. For wallet creation, a link was provided to the *Kukai* app (<https://wallet.kukai.app/>). *Kukai*

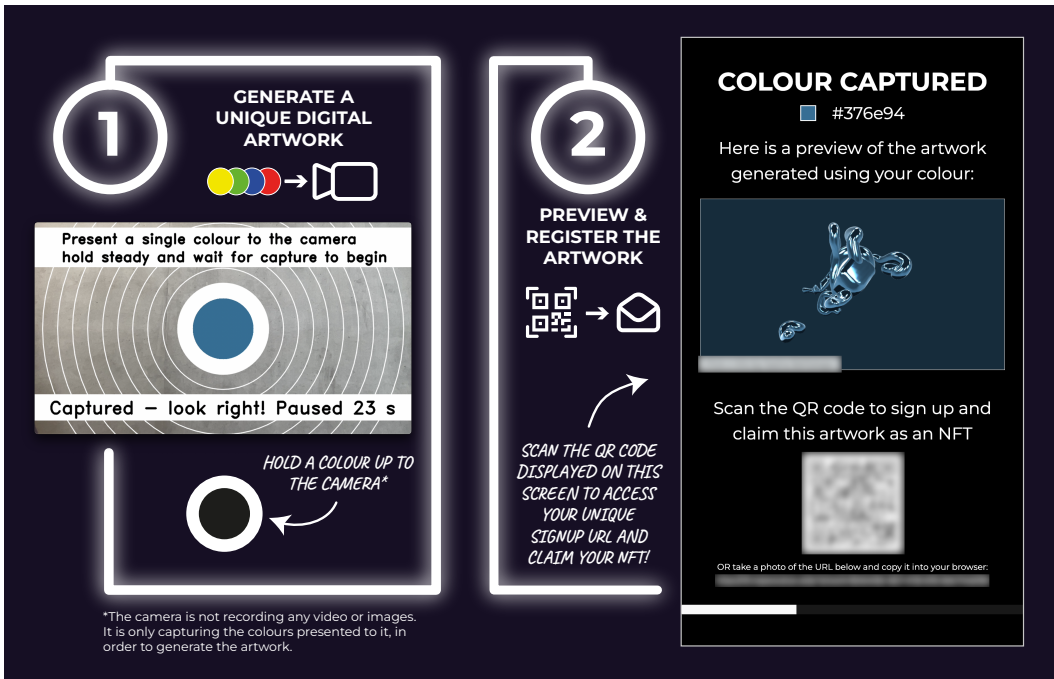


Fig. 3. The capture kiosk, which was installed in a window at the exhibition space.

was selected as the recommended wallet due to its ease of use and the fact that it is web-based, meaning that it could be used on any device with a web browser, and so the minting process could be completed on a mobile device, in situ, if desired. Once the participant had created and connected their wallet they were given the option to mint their NFT by clicking a ‘MINT YOUR NFT’ button [Figure 4]. After clicking the button they were prompted to provide additional consent and, once this was confirmed, an API call was made to the server-side app to mint the NFT. Minting was carried out by the server-side app, and the blockchain ‘mint’ transaction was submitted from a *Tezos* wallet owned by the research team, so that there were no fees for the participant to receive the NFT. Progress updates on the minting process were provided on the minting page, along with dropdown descriptions of each step in the minting process. When minting was complete, the participant was given links to the NFT metadata, *Tezos* transaction summary, and live artwork on IPFS.

5 EXHIBITION CONTEXT, DEPLOYMENT & STUDY PROTOCOL

5.1 Research Ethics

This exhibition and research project were both subject to ethical review and received Institutional Approval. We designed the public-facing exhibition and study carefully to create a safe experience, record only the minimum data necessary, and ensure participants were able to provide fully informed consent.

We ensured there was no possible financial aspect to participating in the exhibition by disabling the ability to transfer tokens between wallets. Participants could neither make, nor were required to spend, any money or cryptocurrency to participate. We also ensured that no personal data of any kind was stored immutably or submitted to a blockchain. We required participants to independently

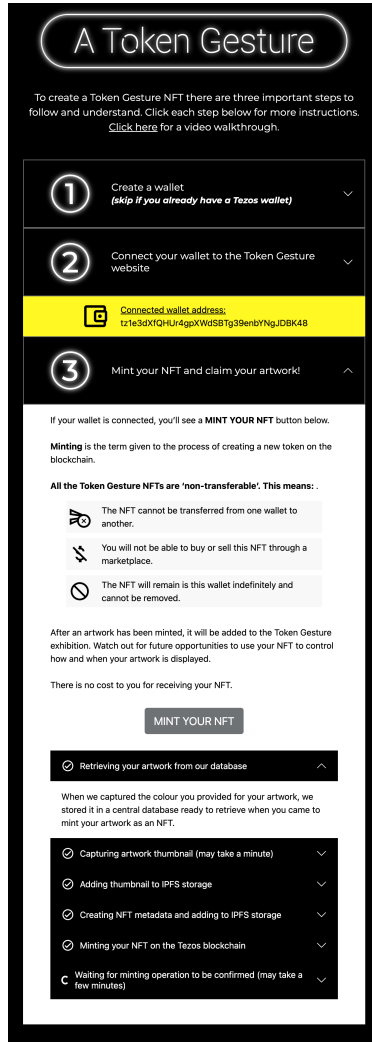


Fig. 4. The minting page guides the user through the three-step process of minting a *A Token Gesture* NFT.

set up their own cryptocurrency wallets (giving them clear instructions about how to safely do this) such that participants' wallets were entirely private. Hence, personal data, such as email addresses, were never connected to any data 'on-chain', such as a wallet address. This ensured that participants could remain anonymous, or subsequently withdraw their personal data from the study. It was made clear to participants that once artworks and NFTs were created, they could not be removed from the blockchain, but on request we could remove them from the exhibition, and they could remove any links they had made to these artworks. We required multiple stages of consent: at the point of reserving artworks, when connecting a wallet to the *A Token Gesture* API and 'minting' an NFT, and when participating in the survey and interview. Participants were also required to confirm they were over 18 years of age. Downloadable information sheets were available at each stage of consent. The project website also included an easy-to-read FAQ, and a public-facing version of our research ethics approval.

5.2 Exhibition Deployment & Events

The exhibition took place at Inspace from March 7th to April 3rd 2022 facing a busy city-centre street. Vinyl signage around a 24-hour kiosk invited passers-by to independently create artworks. Projector screens operating during darker hours, from 4pm to 4am each day, showed all artworks that had been minted. To publicize the exhibition, in addition to promotion via university mailing lists and social media accounts, we held an online launch event to introduce the project, including a conversation with both artists, and a live demo of the artwork creation and minting process. During the exhibition we also hosted a legal seminar and panel on NFTs and copyright, a seminar on the use of NFTs in museums and galleries, and in the final week of the exhibition, we hosted an ‘Ask us NFT-thing’ event to discuss questions raised by the project. While there have been numerous examples of public exhibitions of significant NFT artworks, this live experience of creating and minting NFTs and artworks live and in-situ offered a highly novel experience.

5.3 Participant Engagement and Usage Statistics

During the exhibition, 229 participants engaged with the kiosk to create artworks [Figures 5 & 6]. A total of 1788 artworks were generated, with 186 of these artworks ‘reserved’ – where participants provided an email address, but did not go on to mint their artwork as an NFT. In total, 79 NFTs were minted, by 68 unique participants. Most minted only a single NFT, while one participant minted five separate artworks.

The median time between artwork creation (at kiosk) and minting the NFT was 8h22mins, suggesting most participants undertook the minting process in a separate session. 160 participants (70%) followed their email link to the minting page, and 68 of these (43% of those who visited the page) completed the minting process. Participants had the choice of connecting an existing wallet, or creating a new one to receive the token. Of the 69 wallets (one participant created two wallets) that received *A Token Gesture* NFT, only 2 of these pre-existed the exhibit, and only 4 contained tokens from other projects, and XTZ, the cryptocurrency underpinning the Tezos blockchain. This suggests that majority of our participants had never interacted with the Tezos blockchain before.

Participants were provided clear instructions and walkthrough videos, but were required to complete a multi-step process independently. There are no other studies we are aware of where participants have been independently invited to create a crypto-wallet and undertake blockchain transactions, so it is challenging to benchmark and comprehensively interpret these statistics. However, we suggest that the high percentage of visitors who continued to the minting page indicates a significant level of curiosity and interest following the initial experience. That nearly half of these participants, many of whom - we can deduce from survey results (see below) - lacked prior experience of NFTs, indicates that the system was essentially usable, and the instructions we provided were generally clear. No participants contacted us to ask for specific technical support with minting. Nonetheless, clearly for many other participants the process was either: too time consuming (taking at least several minutes); of unclear value to them; or appeared otherwise off-putting.

5.4 Research Study and Recruitment

After the exhibition, participants who had provided an email address were invited to complete a short survey (available as supplementary material) about their prior experience and views of NFTs, and their experience of the exhibition. Survey participants were invited to participate in a research interview. As an incentive, survey participants were entered into a draw to win one of five £50 shopping vouchers. Interview participants were offered a £20 shopping voucher for their time.

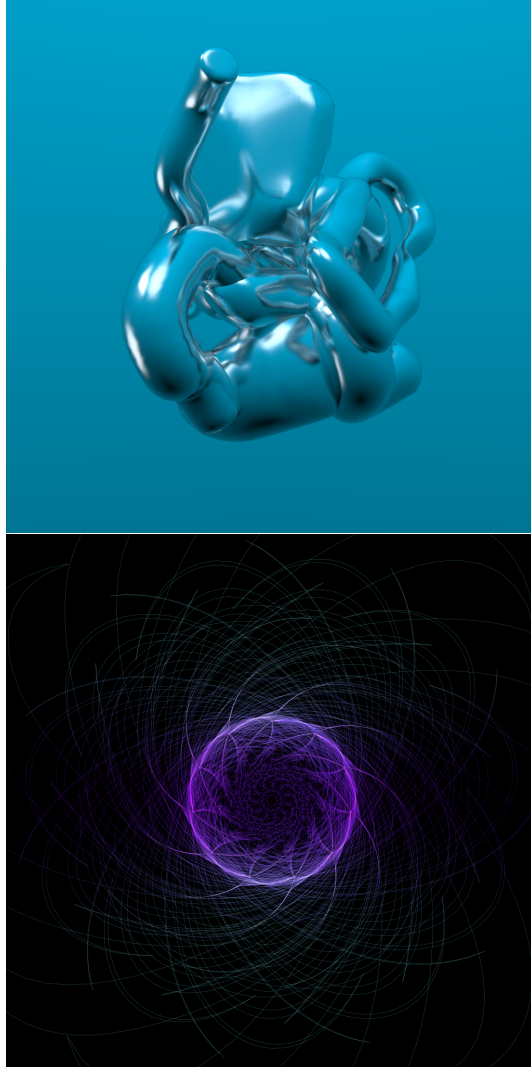


Fig. 5. [Top] Still from generated output of Pick n Mix by Sasha Belitskaja . Pick n Mix features a uniquely coloured collection of playful, rotating, entangled 3d forms. The title is a reference both to the candy-like shapes and the surprise recombination of them with each generation.

Fig. 6. [Bottom] Still from generated output of String by Gingey . String is a spirographic animation that changes based not only on the colour submitted by the user, but the date and time of the viewing.

5.4.1 Survey Results and Participant Sample. The survey received 33 responses (14% of all participants; 43% of all those minting an NFT), and 14 of these (described below) were interviewed about their experiences. Of these, 29/33 survey participants minted a *A Token Gesture* NFT – and therefore this sample over-represents those most engaged with the project. 13/14 interview participants had minted *A Token Gesture* NFT, though as we will see, had diverse views and experiences of this experience. Our analysis in this paper is focused on the much more in-depth data collected through

interviews, rather than statistical analyses of this small-scale survey. However, there are some notable features from the survey that indicate the extent to which *A Token Gesture* was a public experience, which facilitated a diverse group of people to engage, in a real-world context, with an often-exclusive set of technologies. Firstly, 23/33 (72%) participants said they became aware of the exhibition simply passing by on the street – suggesting the effectiveness in attracting a general public to participate. 18/33 (55%) respondents had never owned an NFT before; and only 11/33 (33%) participants said they regularly participate in related ‘Web3’ or ‘crypto’ communities online. This certainly exceeds the level of crypto ownership in the UK [39], and demonstrates that our research was attractive to those with existing interests in crypto. However, it also indicates that the majority of people who participated in the exhibition, and who minted an NFT, had not done so before, and this was a novel experience for them.

5.4.2 Interview Protocol. The lead researcher and interviewer (Author 1) undertook semi-structured, one-to-one online research interviews with 14 participants, each lasting 40-57 minutes. Each interview began asking participants to talk through their experience of the exhibition, creating an artwork, minting an NFT, and sharing this with others. Further questions probed on participants’ relationships to the generative artwork, the token, and what they saw as the valuable features of having minted an NFT. We also explicitly discussed why, and when, proving ownership and / or participation in a project could be important, and invited them to speculate about the kind of actions or utility they sought from ownership of an NFT, in this context and further afield. We discussed the non-transferable and situated nature of the token, and their views on being unable to trade or sell the token. The full interview schedule that guided each interview is provided as supplementary material.

5.5 Interview Participant Backgrounds

As a public exhibition, all participants were self-selecting. We did not collect detailed personal demographics from participants, however, their self-described interest, motivations, and backgrounds varied considerably, as shown in Table 1. Most significantly, though most had some prior awareness of blockchain technologies, only half of the participants had owned an NFT before. Understanding and familiarity with the potential benefits was sometimes linked to having ‘bought in’ to the key concepts of blockchains, but on balance, it also offered prior awareness of the potential flaws of the technology. In some cases, prior experience also meant they had some familiarity with communities that have evolved around NFTs and the social dynamics of these. Novices tended to have a steep learning curve with *A Token Gesture*, and were also assessing the concept from a fresh perspective. They were mostly yet to be convinced of the merits of the concepts, and while most lacked a detailed understanding of the technological processes and possibilities, they often brought a perspective to the subject that was grounded in other aspects of life e.g., working with art or an interest in collecting. Overall, this mixed, public sample offers a valuable cross-section of backgrounds and perspectives, through which to examine the various merits and drawbacks of NFTs as an ownership technology.

5.6 Interview Data Analysis

All interviews were professionally transcribed, and these transcriptions checked by [Author X], who led the qualitative coding of this interview data. We chose to use template analysis, which is “a form of thematic analysis which emphasises the use of hierarchical coding but balances a relatively high degree of structure in the process of analysing textual data with the flexibility to adapt it to the needs of a particular study” [8] (p. 203). In template analysis “*a priori codes might be identified ahead of data engagement, as ‘anticipated themes’ developed from literature or interview questions*”

Table 1. Interview Participants Backgrounds & Motivation

ID	Prior NFT Use	First Encounter with Project	Motivation	Three (or more) Words to Describe NFTs
AD		Passing by gallery	Works in blockchain field	Currently a curiosity with great potential
BN		Passing by gallery	Increase knowledge	Complicated, unnecessary, fad
BS	✓	Project contributor	Novelty of experience	Hard to onboard, difficult, you get what you get
CN	✓	Word of mouth	Participatory aspect	Curious, optimistic, uncertain
DG	✓	Passing by gallery	NFT engagement in local area	Misunderstood, has its uses, innovative
FM	✓	Passing by gallery	Increase knowledge; participatory aspect	Intangible art, web-based, innovative
ON		Word of mouth	Interactive artwork	Playful, quirky, fiddly
RN		Passing by gallery	Interactive artwork	Interesting, future, beautiful, digital, property
RR		Passing by gallery	Increase knowledge participatory aspect	Mysterious online art being traded and sold
RJ		Passing by gallery	Increase knowledge	Cool, incorrect use, limited utility
TM		Social media	Increase knowledge; visual appeal	Unknown, unethical, damaging
TP	✓	Project contributor	Contributing to project	Sceptical, observing from a distance, doubtful
ZA	✓	Passing by gallery	Novelty of in-person minting	Accessible, creative, enabling (artists)
ZE	✓	Passing by gallery	An NFT artist	Positive, innovative, cross-disciplines

[13] (p.244) and these are used to create an initial coding template. The data is then coded, revising the template as necessary to reflect the data, to arrive at a final template. The resulting approach is therefore both inductive and deductive. We approach our analysis from a “subtle realist” perspective, which acknowledges the situatedness of the researcher while allowing for “phenomena that are independent of the researcher and knowable through the research process”, therefore enabling us to “*make claims as to the validity of a representation arising from research while recognizing that other perspectives on the phenomenon are possible*” [8](p.205).

We followed the steps of template analysis. Author 4 familiarised themselves with the interview data, constructed an initial coding template from the interview questions (provided as supplementary material), segmented interview data into semantically cohesive units or quotes, coded a sample of the data, updated the initial coding template and then coded the remainder of the data while refining the coding template [8] (p. 204). At each stage, the coding was discussed with Authors 1,3 and 4. Once all of the data deemed relevant to the research question had been coded, we arrived at a final coding template which is shown in Table 2. As can be seen from the differences between the initial and final coding templates (provided as supplementary material), the analysis for this paper focused on participants’ rich responses around the feelings of ownership inspired by NFTs,

Table 2. Final Coding Template: Factors related to experiences of ownership through Blind NFT Exhibition

Code Level 1	Code Level 2	Code Level 3
1. Non-transferable	1. Monetary value	1. Transferability is key attribute of NFTs
		2. Access to marketplace
	2. Non-monetary value	1. Marker of participation
		2. Lower stress from lack of financial risk
2. Participation and Involvement	1. Situatedness	1. Place-specific
		2 Time-specific
	2. Participation	1. Generating artwork
		2. Minting NFT
3. Sharing and Display	1. Sharing artwork	1. NFT earned through labour
		2. Via social media
	2. Displaying artwork as a status symbol	2. Via Tezos wallet
		1. Showing off collection
4. Connection and Community	1. Connection to NFT artists	2. Showing off monetary value
		3. Showing off familiarity with NFTs
	2. Connection to project	1. Means to offer financial support
		2. Collaborating on an artwork
5. Uniqueness and Distinctness	3. Entry to NFT communities	1. NFT as a memento
		2. Connection to other participants
	1. NFT is unique	1. Sense of belonging
		2. Sense of exclusivity
6. Originality and Proof	2. Value from uniqueness	1. Due to affordances of NFTs
		2. Due to being generative artwork
	1. Attributes granted by NFT contract	3. Due to circumstances of creation
		1. Monetary
6. Originality and Proof	2. Attributes not granted by NFT contract	2. Confers uniqueness to owner
		1. Proof of ownership
	1. Attributes granted by NFT contract	2. Proof of authenticity
		1. Feelings of ownership
6. Originality and Proof	2. Attributes not granted by NFT contract	2. Exclusive rights to artwork
	1. Attributes granted by NFT contract	

and discussions of the wider utility of NFTs –though relevant for our future work – were put aside for this analysis, instead focusing on ownership. The findings section hence presents the themes produced through this coding as a coherent linear narrative for the benefit of the reader, however there are many relations between each theme.

5.7 Limitations

There were a number of limitations and constraints with our deployment and study to acknowledge. The exhibition took place in a busy city-centre of an affluent UK city on a University campus. This will have determined who could interact with the exhibition. As noted above regarding research ethics, we chose to make these NFTs 'non-transferable' – meaning that trading, one practice often tied to ownership, was prevented. In some respects, this limited our perspective on financial aspects of ownership, but being non-transferable was significant to participants' experiences for other reasons, and in fact demonstrated an application of NFTs beyond financial speculation, which was valuable to our study.

Regarding the study itself, the degree of personal data collection we undertook was limited in several ways. First, the exhibition allowed participants to interact independently, ensuring their privacy in setting up publicly visible wallets. Therefore our research relies on what participants told us post-hoc about their experiences at events, through the survey, or in research interviews. Further research to observe how people actually created and set-up their wallets and minted NFTs in situ could reveal greater detail about these specific user interactions. However, this would likely require a more controlled and less naturalistic engagement from participants. Finally, as the exhibition, survey, and invitation for interview were all self-selecting, our participants necessarily represent those most engaged, and most able to engage. Given the privacy-preserving nature of the overall study we chose not to collect extensive data on the demographics of our participants (e.g. gender, occupation, nationality, etc.). However, we can report that interviews demonstrated a broadly heterogeneous sample – of varying ages, gender and especially regarding prior experience with blockchain technologies – which is a more significant factor for our study than any specific demographic.

6 INTERVIEW FINDINGS

Based on our thematic analyses, our findings present a narrative of how interview participants experienced *A Token Gesture*, related to their broader views of NFTs and ownership. Participants often referred to prior knowledge or experience to explain or expand on their thinking around *A Token Gesture*. We begin with the subject of trading and transferability.

6.1 Trading & (Non)Transferability

The *A Token Gesture* NFT was non-transferable, meaning it could not be traded via marketplaces – this is unlike most NFT projects, and was core to participants’ experiences. Nonetheless, during the interviews, several participants explicitly discussed the economic value of NFTs. Those already involved in NFTs described the importance of access to marketplaces. For example, ZE, an artist who mints and sells their own NFTs, described the financial benefits of accessing marketplaces:

“you have a platform that no matter where you are, possibly in a faraway village in Australia that you can still mint your artwork and then being[sic] reached by someone in New York” [ZE].

This direct connection to buyers that ZE describes also speaks to the *disintermediated* aspect of trading NFTs, where distributed ledgers enable a buyer to directly access sellers without the need for a third party. The value of NFTs here resides not so much in the artwork but in the potential to participate in a global network of trade, and potentially make a profit, as an artist, trader, or collector.

As such, for some participants, a non-transferable NFT – excluded from having a financial value – contradicted the benefit of owning an NFT: *“it’s non-transferable so I can’t really sell or transfer it to friends or whatever, it’s just my own thing, I think utility is a big aspect of it so there’s not much utility, it’s just a piece of art, so what’s the future of this NFT? I didn’t really understand. At the moment I’m just holding a piece of art” [ZA].*

Comments like these illustrate a perception that owning an NFT should provide ‘utility’ – to give the token a ‘future’, financial or otherwise, that benefits the holder. However, other participants responded positively to the non-transferable nature of their NFT, either because they had no particular intention to trade it, or in the case of a novice participant, because it simplified the experience, and did not expose them to the stress of an external market for the token. Indeed, participants suggested that removing the ability to trade an *A Token Gesture* NFT produced value specifically *because* it was non-transferable. Since it could not be bought, it certified participation in a specific, one-off experience:

“So they just exist as a mark on the inventory, kind of thing... they have this interesting element of, I was there [...] And I had to be there at the time to get them. So they come under this untradable, they’re now inaccessible, so that’s where the value of them comes from” [TP].

Such a marker had an inherent value for some participants: *“This is permanent, and it’s proof of me, and I did this. It doesn’t have to mean, or have value, or anything, but it’s just something about that is quite pleasing to me” [DG].*

Hence, while the commercial NFT market is underpinned by ownership that facilitates financial speculation, there are clearly also other motivations for acquiring and owning an NFT. The financial underpinning of the NFT market and *A Token Gesture*’s departure from this resurfaced throughout the findings to build a picture of how we value possessions, what motivates their acquisition, and how we construe ownership.

6.2 Participation and Involvement

A Token Gesture was further distinguished from other NFT projects as it required a situated, in-person experience – in both the creation and viewing of NFT artworks. As participant TP directly stated: *“A lot of the interesting part of this was the idea that you’re required to be there physically” [TP].*

Participating artist BS recognised the novelty of this set-up, which prompted reflection on the distinction between digital and physical spaces and objects: *“The NFT is always digital and just in the internet space. So, I think that’s really cool bringing it into the physical world again.” [BS].*

CN also described how the physical presence of the *A Token Gesture* exhibit gave them enjoyment: *“A little part of the experience that I found rewarding was the fact that [redacted: name] sent me a text with a picture of my NFT in, [...] I was like, oh, that’s in the real... it’s not just on my screen, people can walk past it[...] that kind of connection with the real world was interesting and I thought quite powerful.” [CN].*

In order to produce the NFT artwork, participants needed to make a simple design choice by presenting a colour to a camera in the kiosk. This determined aspects of the finished NFT artwork [Figures 5 & 6]. Participants enjoyed making this colour choice, and what this involvement meant for the subsequent artwork produced, which some participants then saw as a personalised expression of themselves:

“It wasn’t just like, oh, select from 100 NFT things and customise that and we’ll just mint it for you, this was more my personal thing because I could just pick a leaf or a blade of grass or whatever and show it to the camera and have my very own unique colour.” [ZA]. For TM, the act of personalising the artwork made them feel *“part of the art rather than just a consumer of it.” [TM].*

Other participants felt less responsible for the resulting artwork: *“it’s not like I felt like I created this piece of art and also because it’s not like it was my algorithm [...] like any sort of other interactive piece of art in a museum, where you might take a part in it but it’s not your art.” [AD].* Interestingly, however, for AD this sense that they couldn’t claim authorship of the artwork did not inhibit the feeling of ownership of the NFT produced, as AD themselves said *“I definitely referred to it as mine” [AD].*

Within *A Token Gesture* participants needed to mint the NFT themselves in order to acquire it, rather than buying it from an artist directly or via a secondary marketplace. This process of personally minting the NFT was seen as an integral part of the experience. DG described it as: *“like, it is art, you know, the whole process was art, you’re actually minting something, the transaction is part of the art.” [DG].*

Some participants also reported that the minting process enhanced their feeling of having earned the NFT, in particular because they had to engage with the technological steps involved in minting:

“it definitely feels like I’ve earned it, like I’ve learned something from it, I’ve gone through this process and I know kind of what it is.” [FM].

For most participants then, involvement in the process enhanced their sense of ownership of both the artwork and token. The process of earning ownership through participation is part of what creates the meaning of the *A Token Gesture* NFT. This process was *“much more meaningful for me that I’ve created it rather than just bought it” [TM]*. Examples like this, emphasise how NFTs can be meaningful to participants without any financial applications.

Participants’ interest in the non-transferable qualities of the *A Token Gesture* NFT, and the labour to earn the token, resonates with recent proposals for ‘soulbound’ NFTs [79]. These are proposed to represent the *“commitments, credentials, and affiliations”* [79, p. 1] of a token-holder, which cannot be bought and sold, but may be important to develop trust or identity. In this respect, ownership of an NFT can offer a way to show or prove something about oneself. Participants found value in the *A Token Gesture* NFT as proof of participation, and this led to their desire to share the token with others.

6.3 Sharing and Display

Participants in *A Token Gesture* cited the importance of being able to share their NFTs and artwork. During the exhibition, the finished artworks were exhibited on large projection screens [Figure 1], and participants also shared their NFTs in conversation and online: *“When I was at [exhibition space][...], I took a bunch of pictures and made like a collage on my Instagram, alongside the artwork, and I’ve had more engagement with that than I have the actual NFT.” [TM]*.

Participants like TM contrasted the lively engagement on social media to the more limited interactions around the NFT actually in their wallet. Three participants in particular (DG, FM and TP) were enthused by the idea of displaying wealth, status, and knowledge to others:

“I think it’s your public library or whatever, it’s what you have to show off.” [TP]

“Maybe it was for selfish reasons to say, look, now I’m tech-savvy and you’re not, to showcase that I know what NFT is.” [FM].

Display can also be particularly valuable as a way to signify involvement and support. DG explained that while showing off ownership of items acquired through purchase can be *“really negative”*, ownership earned through direct participation can be both more accessible, and a sign of commitment: *“if you’re showing off something that you’ve worked really hard for, that anyone, if you put the work in, you could get the same thing. I think that’s a very different aspect of showing off, and proof of ownership” [DG]*.

Despite the fundamental public visibility of NFTs, some participants were critical about the poor experience design of Tezos wallets, and the lack of interoperability between different wallet apps, and other media platforms which were further barriers to displaying their NFTs. *“If the wallets become interoperable and interchangeable and you can share them across other wallets and then wallets can be connected to Web 2.0, aka Twitter or YouTube or Instagram [...] then it immediately gives meaning to owning those NFTs. But at the moment there’s not much meaning.” [RN]*.

These complaints highlight a tension between what people want to do with their NFTs and the current functionality of the technology and ecosystem.

6.4 Connection and Community

The *A Token Gesture* NFT provided participants with a connection to something larger than themselves: to the artists, to the *A Token Gesture* project, to other *A Token Gesture* participants, and to wider NFT communities. Like a souvenir, some participants saw the *A Token Gesture* NFT as connecting them to University of Edinburgh: *“it’ll just always be something there in my wallet to think back to that very first NFT project that University of Edinburgh did.” [DG]*.

ZA introduced the potential of NFTs to develop and maintain a connection between artists and audiences: *“When you have that NFT you relate to the artist and you follow their experience, their journey”* [ZA].

For BS, *A Token Gesture* offered an entry point into the wider ‘world’ of NFTs: *“for people who tried it for the first time it’s going to explain the process via the process. So, now they are able to explore the NFT world.”* [BS].

For BN it connected them to others who *“have done the same thing [...] I suppose, am one of those people. So, it feels like, oh, there are lots of other people who had the same, sort of, thought process as me.”* [BN].

Distinctions became evident between participants who were invested in the concept of blockchain technology and those who were more sceptical. This manifested in their discussion of NFT communities as being a blend of inclusivity and exclusivity where those on the inside feel special. Participants experienced with NFTs talked about the benefits of online communities *“there’s a nice little community coming together to answer all your questions about most things, you know, to kind of build everyone up.”* [DG].

However, exclusivity for those on the inside requires people on the outside: *“it was just fun to see something that was such a niche thing, to know that half the people walking down that street would see the sign and not even know what it meant, right?”* [AD].

For those on the outside, knowledge is a barrier to entry: *“if you don’t understand them then it’s not really for you, and it’s for a certain type of person to understand”* [BN].

Participants new to NFTs talked about how *A Token Gesture* gave them access to this space: *“It just seemed that I felt included in all this news, all of a sudden”* [RR]. This appeal to economies of knowledge is resonant of subcultural capital, where *“Subcultural capital confers status on its owner in the eyes of the relevant beholder”* [73, p. 27] in this case, others who are shared believers in particular NFTs and the decentralized futures they represent.

6.5 Uniqueness and Distinction

Participants described how taking part in *A Token Gesture* felt like something unique. This included the creation of generative artworks where every image produced was unique, and its link to a unique NFT. This uniqueness made the NFT and artwork feel valuable to participants, and they described it as a form of scarcity: *“You feel a different way about it [...] the scarcity thing, so the one-of-oneness of it.”* [CN].

For TP the difficulty in obtaining an asset, making it rare, makes it more desirable: *“in a sea of tradable items, NFTs or whatever, it’s kind of part of what makes it so interesting, I think. Everyone wants that, you can’t even get it.”* [TP].

Owning something unique or rare conferred a quality of unusualness and distinction to personal identity: *“the uniqueness element adds extra value onto it. Especially for somebody in my generation, because we don’t want to be seen as the same as everyone.”* [TM].

TM went on to relate the value in the artwork to other expressive possessions, explaining the importance of exhibiting difference in order to convey individuality: *“we all buy fast fashion and the last thing you want to do is go out and see somebody wearing the same thing as you. And, if you go to someone’s house, you don’t want to see the same pictures framed, you want to have your own personality viewed. And I feel like sometimes those are an extension of what somebody views as themselves”* [TM].

ON likewise combined scarcity with personal meaning, arguing that an object with both is even more valuable: *“So it’s not scarcity due to finances. It’s scarcity due to –this is weird and obscure – and that probably is also like reflected in [my] mentality in general [...] like the more obscure the film, the happier I am to have seen it.”* [ON].

This example demonstrates how values can be subculturally determined. Developing the findings from the previous section, we see how ownership of a scarce or unique NFT can be desirable when it is a recognisable badge of both individuality and belonging to a particular community. Furthermore, when an NFT can also symbolize how it was earned, through participation within and commitment to certain processes or communities, it can become more meaningful still. For several participants, these qualities were seen as more important than wealth and financial value.

6.6 Originality and Proof

Finally, core to the discussion of uniqueness is the extent to which NFTs can genuinely prove and facilitate a unique digital possession when the artwork itself can be copied and shared like any other digital image. This conversation often converged on notions of originality. For CN, it is the concept of owning an original that marks the NFT out as valuable: *“being able to prove that it’s one of one and yours and only you can have it. Whereas, the right-click, save as, I would [...] think of that as the same thing as taking a picture of a painting, of, you know, a Van Gogh or something and saying I own that. You don’t own it, you own a picture of it.”* [CN].

In each interview, participants were asked how they would have felt if, instead of minting an NFT, the research team had emailed them a digital certificate. For TP: *“as soon as you say you send me an image and an email, that really does become nothing”* [TP].

ZE offered this explanation of how they distinguish between an NFT artwork and a copy: *“You’re trying to get something deeper behind it and when people are getting it, they’re buying the concept instead of actually buying the stuff. Well, of course at the end of the day you can always use it [the artwork] as a Twitter profile picture, but what I’m selling here is also selling this concept.”* [ZE]. This view advocates that the NFT - the token - and the concept it represents, is the real source of value, rather than the a more superficial artwork, which can indeed be easily and exactly duplicated.

Several participants who already participated in crypto were explicit about how an immutable distributed ledger of transactions could demonstrate and trace ownership. The role of a blockchain in this context is not to prevent digital copies, rather to enable owners to prove the authenticity of their specific token: *“if somebody comes in with a fake, you can be like, actually, I can show you on the blockchain that it’s only mine.”* [TM].

BS also described their faith in the transparency of blockchain technologies: *“The most important thing about NFT is being able to certify who owns it and who created it”* [BS].

ZA described how it is the public availability of this information that helps to protect ownership status: *“I think ultimately an NFT gives you the proof of ownership, that’s the biggest value and you chose Tezos so it’s on a public blockchain and it can be verified by anyone that you really own the piece.”* [ZA]. In practice, ongoing questions around how copyright is transferred with NFTs, and various forms of theft of NFTs, complicates these viewpoints [67].

As such, some participants also questioned the practical benefits of this form of ownership. Participant ON explained: *“Like I understand all of the theoretical benefits of them, that’s very different from, is it a tangible enough benefit for me to do it again?”* [ON].

Similarly, BN described how, in the context of this exhibition, it’s possible for anyone to use the image of the artwork: *“Someone could just screenshot it, and someone could make that their, like, phone background”* [BN]. They went on to ask: *“why, sort of, claim ownership over that?”* [BN].

Similarly, ON elaborated that while a unique relationship to an artwork can be indelibly preserved through the token metadata, this often has limited impact on how an artwork can be actually used and reproduced, normally a central focus of ownership via copyright: *“If a thing is a born digital artwork and you wanted to display it in your home in a non-digital form, is that a thing the artist would permit or not? ...that may or may not be a thing that the artist would ever want to have happen.”* [ON].

Despite collecting NFTs themselves, CN highlighted a remaining deficit in the experience: *“the uniquely immutable record on the blockchain ascribes the thing to you and you alone; that’s, I suppose the technical way of thinking about it. In the moment, I would be lying if I said I had this amazing sense of ownership, to be honest.”* [CN]. In this way, while many participants could be clear about how NFTs technically accounted for ownership, it appears there is still more that could be done for this to be truly felt and experienced by end users.

7 DISCUSSION

NFTs hit the mainstream in 2021 primarily by offering a way to recognize and trade ownership of digital artworks. Being able to buy and sell something is one of the most evident ways to demonstrate, experience, and benefit from ownership. However in this paper, we sought to identify broader values of owning an NFT, beyond financial trading and speculation. Since the *A Token Gesture* NFTs were non-transferable, they could not be bought or sold, and so a sense of possession and meaning was necessarily developed in other ways (Section 6.1). We saw participants personalising artworks, choosing colours, and minting a token for themselves. This labour was key to a sense of ‘earning’ and owning the resulting NFT (Section 6.2). Participants also sought social interactions, and described the value of sharing and displaying their participation in this unique art project to others – either anonymously and publicly through the main exhibition, or personally and privately through traditional social media. Yet, many identified challenges doing so (Section 6.3). The experience, artwork and NFT itself were seen as means to connect to an artist or become a part of a wider community or subculture. However, participants variously described the potential exclusivity granted and enforceable through NFT ownership (Section 6.4). The uniqueness of the experience, the artwork, and the authenticity of the token were all key in creating value. Holding a demonstrably scarce artwork and token was envisaged and interpreted as a badge of both individual taste and values or belonging to an often-exclusive club (Section 6.5). Perhaps the most enticing feature of NFTs is the means to prove uniqueness and originality, heralded by several participants. Our interviews show participants seeking and valorising authenticity of digital possessions, and speculating about what this could mean. And yet, in practice, for most participants these benefits remain more conceptual or theoretical, than practically felt and experienced (Section 6.6).

Besides these particular experiences of a non-transferable token, our primary research contribution focuses on the extent to which ‘ownership’ – mediated via distributed ledger technologies – is required to facilitate many of the experiences we have just summarised. To this end, we turn finally to discuss the implications of our work regarding the application of NFTs as ownership technologies, and more broadly, for ‘ownership design’ as an ongoing concern for the CSCW community.

7.1 NFTs beyond Financial Speculation

Though the subsequent utility of *A Token Gesture* NFTs was limited, it’s evident that they nonetheless produced many kinds of value for our varied participants. At the very least, this shows that NFTs can be much more than their most familiar appearance as over-hyped financial assets. The role of NFTs in marking and recognizing participation – as a kind of personalized souvenir or membership – bears potential for other contexts, such as ticketing for live events or interactive museum experiences [74]. These are contexts where people already want to authentically share, document and record their experiences – non-transferable NFTs could provide independent ways to support this.

Our findings also developed the idea that NFTs are a means to own and *demonstrate relationships to digital media*. On this basis it is worth returning to Odom et al.’s original proposal that the careful design of metadata could address the challenges of digital possessions that are placeless, spaceless, and formless [59, p. 992]. For example, to address placelessness, Odom et al. suggest that *“metadata could be used as a binding element to keep track of location and status, and to interact with and apply*

changes directly to them" [59, p. 992]. NFTs may be considered as this "*binding element*", offering means to anchor otherwise placeless things. Indeed, in this case, through the real-world kiosk, the creation of NFTs themselves was bound to a particular place. This binding might relate to communities of token-holders, or support the experiences of collecting [78] or reminiscence [4]. Other HCI projects have also considered location-based smart contracts specifically as ways to facilitate place-based interactions [71].

As an ownership technology, we suggest that NFTs can provide novel means to create, control, and ultimately own the metadata related to an artwork or any other media. This metadata – determined and fixed by the design of a token contract – creates and protects records of relationships between digital objects and wallets. Regardless of circumstance (e.g. theft), possession of the private keys to control a wallet is taken as proof of ownership by the governing token contract.

The decentralized and public nature of this metadata means that ownership of a token may be independently demonstrated and addressed; any external party can develop services that recognize and reward these relationships. For example, another university could independently recognise, send tokens, or reward any holders of *A Token Gesture* NFT. Hence, different benefits and experiences of ownership may be foregrounded through NFTs. For example, the design of NFT marketplaces (e.g. *OpenSea*, *Objkt*) emphasise trading and financial gain as essential aspects of ownership. Elsewhere, *Discord* servers and voting platforms like *Snapshot* (<https://snapshot.org/>) that are limited to token-holders can facilitate membership and voting rights based on token-ownership. In our exhibition, through non-transferability, ownership was tied to participation and labour, since these were the only ways to create and 'earn' tokens.

Looking beyond which specific benefits, experiences, or cultures that NFT ownership may facilitate, it is important to identify when and where decentralization and more independent forms of ownership are ultimately necessary. Currently, end-users and organisations license digital services, but their cloud-based accounts and metadata are ultimately owned, managed, and mediated by centralized platforms. Platforms are more accountable to deliver services promised, and responsible for managing and supporting end-users, however, there are limited terms to how this data can be used off-platform. The value and implications of these trade-offs will vary. As an ownership technology, what NFTs offer is means to claim ownership of relationships to other data and media – in particular, proving participation, authenticity, or histories. What remains to be designed are the applications and interactions with this rich metadata.

7.2 Ownership Design

Finally, we suggest that the emergence of NFTs and proposals for 'Web3', as well as recent moves to define legal terms and new forms of personal property related to digital assets [60], reveals a broader need to reconsider ownership more explicitly as a subject for design and study. 'Ownership Design' is introduced by Heller & Salzman [35] to draw attention to the ways in which different instinctive ownership rules govern our everyday interactions: from how we queue for theatre tickets, to where one can park a car. Crucially, they highlight that choices about how and when we choose to draw on different rules deserve greater scrutiny and can be designed towards for outcomes; be that ensuring equitable common access to essential resources, creating more competitive marketplaces, or encouraging sustainable working practices. Our participants showed concern for how ownership of digital things is both practically achieved and experienced. Our study also affirmed that ownership is about more than being able to buy and sell things; indeed, by limiting the opportunity to simply 'buy in' to *A Token Gesture*, other ownership stories around labour or locality became privileged. This is but one example of Ownership Design.

There are several specific domains relevant to CSCW in which ownership design appears most immediately salient – for example, in music and media streaming, gaming, handling photo and

video collections, and managing social media content. The collaborative production, and use of media in these contexts is riven with questions about ownership. Ownership design also relates to discourses more broadly on the independent control, withdrawal, and portability of personal data [49]. Whereas these discussions often land on determining the rights and responsibilities of different actors – we suggest that developing approaches to *ownership design* may help increase awareness, uptake, and benefits of these rights in practice.

There are opportunities to design particular ways of coming into ownership of digital things. Perzanowski & Schultz [62] illustrate how a ‘buy now’ button on an eBook is a kind of dark pattern [29] that leads to false belief in the ownership status of these digital things. We could consider design that enables us to more clearly distinguish between different ownership models: I am buying a book that I own permanently but can divest myself of by giving to someone else, versus I am temporarily renting this book at the discretion of the platform [30]. As above, NFTs could communicate that what is being acquired is the metadata and ownership history of a digital object, creating value in a single specific, non-fungible, irreplicable instance amid infinite copies.

After acquiring objects, Odom et al’s [55] original work illustrates that the things people own often form a core part of their identity and shaping how they relate to others. For example, if switching to a new music streaming platform, owning metadata related to user-created playlists may be important to maintaining one’s musical identity. Amidst infinite streams of media and content, NFTs may provide persistent means to mark out and distinguish relationships to important digital things. Though, if this is the case, it is important for digital systems to support the distinctive curation [33, 84] and display (privately or publicly) of these possessions.

Beyond enabling display, ownership is crucial in facilitating and signalling relationships or participation. Owning a stake in a social structure has the potential to be cohesive (especially for decentralized, online communities) but also exclusive. Researchers in CSCW might particularly consider means to facilitate collective ownership of digital things. Belk [6] describes how objects form not only part of our individual identities but also part of collective identities. In studies of digital collections, Gruning & Lindley [31] highlight a lack of attention to the design of shared digital possessions and call for “*more nuanced differences in the ownership spectrum, and supporting their enactment and representation*” [31, p. 1185]. Many token-based systems place particular emphasis on the temporality of holding a token – creating a competitive categorization of ‘early’ and ‘later’ investors in a project or community (likewise, streaming platform *Twitch* rewards subscribers with badges based on their term [20]). In our exhibition, since tokens included the input HEX code as a unique, defined attribute, we could have created distinctions or connections between token-holders who owned artworks of a certain hue, to create red, green, or blue ‘teams’ for subsequent collaborative events and activities. These are examples of how the ownership of particular metadata can be designed towards collaborative interactions and work. Beyond NFTs, researchers exploring new data-driven services and experiences (e.g. [16, 33, 57, 81]) should consider how and when greater ownership of users’ metadata may become more significant.

8 CONCLUSION

We set out to explore the extent to which NFTs and ‘Web3’ technologies offer meaningful forms and experiences of ownership, beyond financial speculation, responding to longstanding interest in HCI and CSCW around digital possessions. In a situated, design-led project, we developed a unique public and interactive NFT exhibition and minting experience, through which we engaged a diverse, ‘non-expert’ audience in our research. Since the NFTs produced were non-transferable, and participants invested time and interest in the artworks and minting process, these tokens were valued as a means to prove and share participation, demonstrate originality, and potentially to connect with other token-holders. Crucially, this illustrates the possible meanings of NFTs beyond their most familiar

use as a speculative financial asset. Beyond presenting a novel interactive system for critical public engagement with NFTs, our findings speak to two broader conclusions. Understood as an ownership technology, NFTs present more independent means to define, secure, and demonstrate relationships between people and their digital things and media – to have metadata that is definitive, widely trusted, and interoperable. Secondly, while prior work has identified metadata as a contemporary design material, we link this to a new concept of *ownership design*, and encourage the HCI and CSCW communities to give renewed attention to how ownership is designed and enacted through networked, digital systems.

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