

Trace Flux Auctions: Observable Contribution Exchange in Distributed Environments

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ABSTRACT

The rapid advancement of blockchain technology has introduced new possibilities for secure digital ownership and transparent fundraising through Non-Fungible Tokens (NFTs). However, most existing charity platforms remain centralized, limiting transparency, accountability, and verifiable proof of donations. Donors often lack visibility into how funds are utilized, while reliance on intermediaries increases risks such as data manipulation, reduced auditability, and decreased trust. To address these issues, this work proposes a decentralized charity auction framework that leverages blockchain technology and NFT-based asset representation. The system is developed using the Django web framework integrated with Web3 infrastructure and smart contracts. In this model, each auction item is tokenized as a unique NFT, ensuring authenticity, traceability, and immutable ownership. The platform allows users to act as donors or auctioneers, enabling participation in NFT-based charity auctions. Users can place bids or contribute funds, with all transactions securely recorded on a blockchain ledger. At the end of each auction, NFT ownership is automatically transferred to the highest bidder or contributor, providing verifiable proof of participation. By removing intermediaries and incorporating a transparent, incentive-driven mechanism, the proposed system enhances donor trust and engagement. It ensures tamper-proof record-keeping and clear fund flow, strengthening accountability within charitable ecosystems. This framework demonstrates a scalable and efficient approach to modern fundraising, showcasing the potential of blockchain and NFTs in improving trust and transparency in charity applications.

Key words: Blockchain, Non-Fungible Tokens (NFTs), Smart Contracts, Decentralized Applications (DApps), Charity Auctions, Transparent Fundraising, Web3, Digital Ownership.

1.INTRODUCTION

Charitable giving has long been a fundamental aspect of human society, enabling individuals and organizations to support meaningful causes and contribute positively to the world. From assisting vulnerable communities during crises to promoting scientific research and supporting the arts, philanthropy plays a vital role in shaping societies and improving lives shown in figure 1. To maximize its effectiveness and maintain public confidence, it is essential that charitable activities are conducted in a transparent, efficient, and trustworthy manner [1]. The advent of blockchain technology, along with smart contracts, offers a significant opportunity to enhance traditional donation systems by addressing existing challenges and enabling a more reliable and equitable framework. In recent years, increasing concerns regarding transparency and accountability in the charitable sector have highlighted the need for improved donation processes. Consequently, many organizations have started adopting technological solutions to enhance donation tracking and ensure greater transparency [2].

Blockchain technology emerges as a promising solution in this context. As a decentralized digital ledger, it facilitates secure, transparent, and tamper-resistant transactions. By leveraging blockchain, donation tracking systems can maintain immutable records of all transactions, ensuring that contributions are delivered to their intended recipients [3]. This level of transparency helps build trust within the charitable ecosystem and can encourage greater participation in donation activities. However,

traditional donation systems continue to face several limitations that affect their transparency, accountability, and operational efficiency. A major concern in conventional systems is the lack of transparency throughout the donation lifecycle. Donors often find it difficult to monitor how their contributions are utilized, making it challenging to verify whether funds are used for their intended purposes.

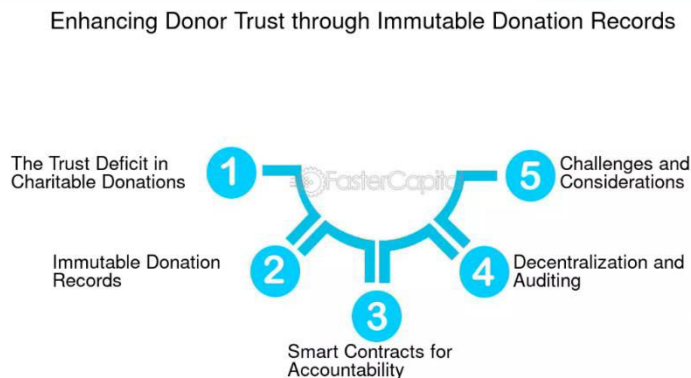


Figure 1: Enhancing Donor Trust through Immutable Donation Records

This limitation also restricts organizations from effectively demonstrating their impact and establishing credibility with contributors [4]. In addition, traditional systems rely on outdated processes that result in delays and limit real-time access to information for donors. Security concerns further complicate these systems, as centralized platforms are susceptible to fraud and data breaches. Their limited adaptability also restricts timely responses to urgent situations. Another significant drawback is the high transaction cost associated with intermediaries such as banks, credit card providers, and payment processors, which reduces the actual amount of funds reaching the beneficiaries [5].

2.LITERATURE SURVEY

Stublic, H et al. [6] proposed models, and research will be highlighted. Archives are currently leading the research into the use of blockchain technology and have already developed models such as TrustChain. However, libraries, museums, and galleries are also beginning to show an interest in the new technology and its potential benefits. Therefore, they also approached the GLAM sector, to emphasize the importance of the joint development on the advancement of shared approaches and protocols in utilizing blockchain technology to enhance the trustworthy management and preservation of digital resources. Bao, et al. [7] conducted a systematic review of the research work on NFT, published in journals indexed at the Web of Science and ScienceDirect until April 2022. The results reveal that there are 13 published articles in the targeted journals, and they are mainly focused on the asset pricing area. The gaps identified in the literature also can be the opportunity for future study. Thus, they lay down the agenda for the future in several important but unanswered fields related to asset pricing, tokenomics, and risk and regulation.

Pereira, et al. [8] explored NFTs have been used in several markets: games, arts, and sports, among others. In 2020, the volume of negotiations of the NFTs was about USD 200 million. Despite the strong interest of economic agents in operating with NFTs, there are still gaps in the literature, regarding their dynamics and price interrelation with other potentially related assets, which deserve to be studied. In this sense, the main purpose in this paper is to analyze the cross-correlation between NFTs and larger cryptocurrencies. Bourron, et al. [9] proposed NFT a digital asset that had been generating buzz in recent times. The astounding price fetched by the NFT sent shockwaves through the art world. While the 255-year-old auction house was known for selling unique assets, its auctioning of an NFT was

surprising as Christie's online marketplace was not on the blockchain, contrarily to NFT platforms such as Opensea, Nifty Gateway, etc. The resounding success, however, of its historic auction was followed by a surge of NFT off-chain sales at Christie's, Sotheby's, and Phillips.

Sidorova, et al. [10] emerged as a disruptive force in the art market, fundamentally altering the landscape of art ownership and challenging traditional models of art collecting. Built on the robust foundation of blockchain technology, NFTs function as unique digital certificates, each representing ownership of a specific digital asset. This encompassed a wide spectrum, from digital artworks and music to even virtual real estate within the burgeoning metaverse. The core value proposition of NFTs is compelling: to revolutionize the art market by empowering artists, democratizing access, and enhancing the transparency and authenticity of art transactions. Madanchian, et al. [11] explored the transformation of business frameworks during the era of NFTs and the Metaverse. It delves into traditional paradigms, clarifies the unique characteristics of NFTs, and examines their potential impacts on commerce. They investigated the convergence of virtual reality (VR), augmented reality (AR), and blockchain technology within the Metaverse.

Low, et al. [12] discussed the myths regarding the energy costs for "mining" cryptocurrency and explore some of the technological advancements that will reduce the carbon footprint of utilising blockchain technology going forward. They also detailed case studies of several conservation NPOs who have begun to adopt blockchain technology in their operations. They propose that the increasing use of blockchain technology could generate new revenue streams, enhance operational efficiency, and strengthen stakeholder trust to deliver impactful conservation outcomes and encourage NPOs and policymakers to begin pilot explorations of blockchain applications. Valeonti, et al. [13] provided an opportunity for fundraising for galleries, libraries, archives and museums (GLAM), by selling ownership of digital copies of their collections? Although NFTs in their current format were first invented in 2017 as a means for game players to trade virtual goods, they reached the mainstream in 2021, when the auction house Christie's held their first-ever sale exclusively for an NFT of a digital image, that was eventually sold for a record 69 million USD. The potential of NFTs to generate significant revenue for artists and museums by selling effectively a cryptographically signed copy of a digital image (similar to real-world limited editions, which are signed and numbered copies of a given artwork), has sparked the interest of the financially deprived museum and heritage sector with world-renowned institutions such as the Uffizi Gallery and the Hermitage Museum, having already employed NFTs in order to raise funds

Bellagarda, et al. [14] discussed and addressed that data storage of the underlying digital asset connected to an NFT is held off-chain in most cases and is therefore out of the NFT holders' control. This issue will be discussed and addressed using a theoretical workflow developed and presented for a system that converges NFTs and verifiable credentials with the aim of storing underlying NFT digital assets in a decentralized manner. Bhujel, et al. [15] Non-fungible Tokens (NFTs) are ownership records stored on a blockchain, and they are typically digital items such as photos and videos. In many ways, an NFT is like a conventional proof-of-purchase document, such as a paper invoice or an electronic receipt. NFTs are attractive among other things because of verifiability; each sale is recorded as a blockchain transaction, allowing ownership to be tracked. Also, NFTs can be used to transfer digital assets between two mutually distrusting parties, since both the crypto payment and the asset transfer take place in one transaction. With NFTs, all marketplaces can freely trade with the help of decentralized applications (DApps). It is currently estimated that there are over 245 NFT marketplaces (NFTM) listed with over 1000 blockchains as of August 2022 with 68 million blockchain wallet users.

3. PROPOSED SYSTEM

The proposed system provides a transparent and immutable framework for donation verification. It is a web-based decentralized application (DApp) designed to enhance trust, accountability, and transparency in the charitable donation process. By integrating blockchain technology with NFTs, the platform ensures that all auction and donation transactions are securely recorded and can be publicly verified in real time. The system operates as a digital charity auction platform where auctioneers can list items or causes for fundraising, and donors can participate either by placing bids or making direct donations. Each auction and donation transaction is logged on the Ethereum blockchain through smart contracts, guaranteeing immutability of data including donor details, bid amounts, auction IDs, and transaction statuses as depicted in Figure 2.

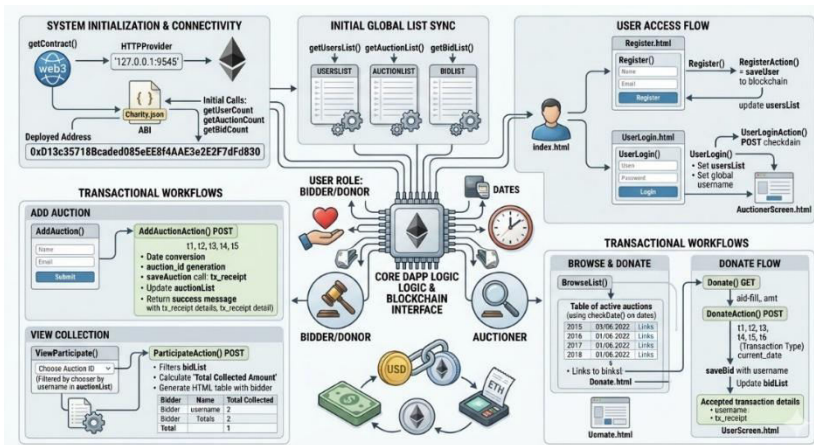


Figure 2: Proposed blockchain-based charity auction & donation system architecture.

This decentralized approach eliminates reliance on intermediaries or central authorities, thereby reducing the risk of fraud and fund mismanagement. The backend is developed using Django, while blockchain interactions are handled via Web3. The platform connects to a local Ethereum network to deploy and execute smart contracts written in Solidity, which manage all core operations, including user registration, auction creation, bid submissions, and donation verification. Users can register as either Auctioneers or Donors/Bidders. Auctioneers can create and manage auctions, define donation categories, and track total collected funds. Donors can browse active auctions, place bids, and verify their contributions using blockchain transaction receipts. The user interface is designed to be intuitive, ensuring a smooth experience while blockchain-level security operates seamlessly in the background. By combining decentralization, NFTs, and transparent transaction recording, the platform guarantees that every donation is traceable, secure, and verifiable. This system not only strengthens donor confidence but also establishes a scalable, ethical, and blockchain-driven model for global charitable initiatives.

4. RESULTS ANALYSIS

The results demonstrate the successful implementation of a blockchain-based NFT charity auction system that ensures transparency, security, and user trust. The system provides a seamless interface for both auctioneers and donors, enabling secure login, auction creation, and participation. Each action, including user registration and bidding, is recorded on the blockchain, ensuring immutability and verifiable transactions. The platform effectively eliminates intermediaries while maintaining real-time tracking of donations and bids. The results confirm that the system enhances accountability, prevents data tampering, and improves donor confidence in charitable fundraising.

Figure 3 depicts the NFT charity auction creation and completion process. This stage records auction metadata and NFT details onto the blockchain network. Successful auction creation is validated through

blockchain transaction confirmation. The immutable storage ensures auction authenticity and prevents tampering. This figure highlights decentralized auction initialization within the system.

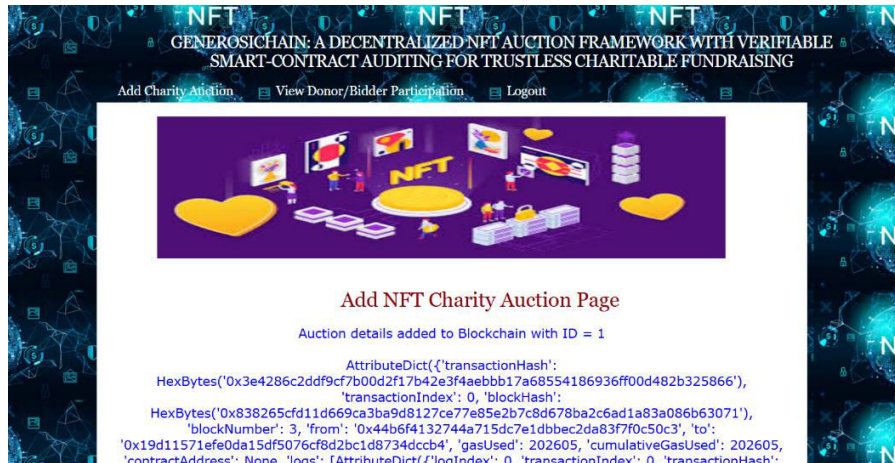


Figure 3: Add NFT charity auction completion page

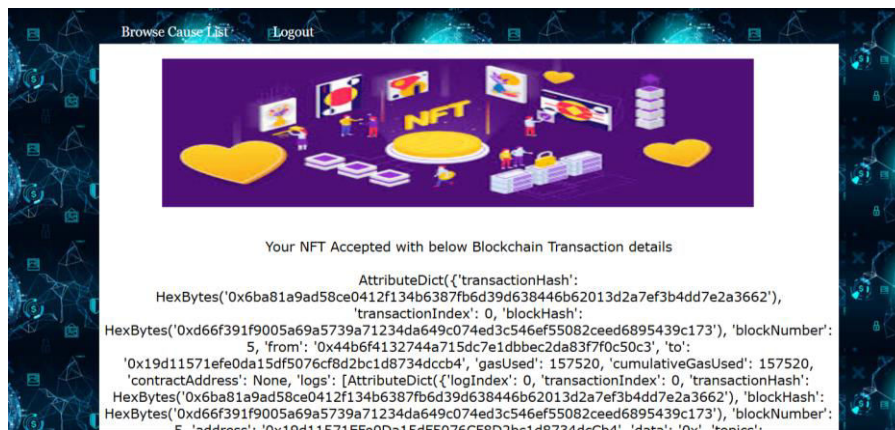


Figure 4: Bidding login page

Figure 4 illustrates the bidding interaction and transaction confirmation stage within the system. This phase records donor bids and validates them through blockchain consensus. Each bid is stored as an immutable transaction to ensure fairness and transparency. The system prevents bid manipulation by maintaining a decentralized audit trail. This figure represents the core transactional logic of the auction process.

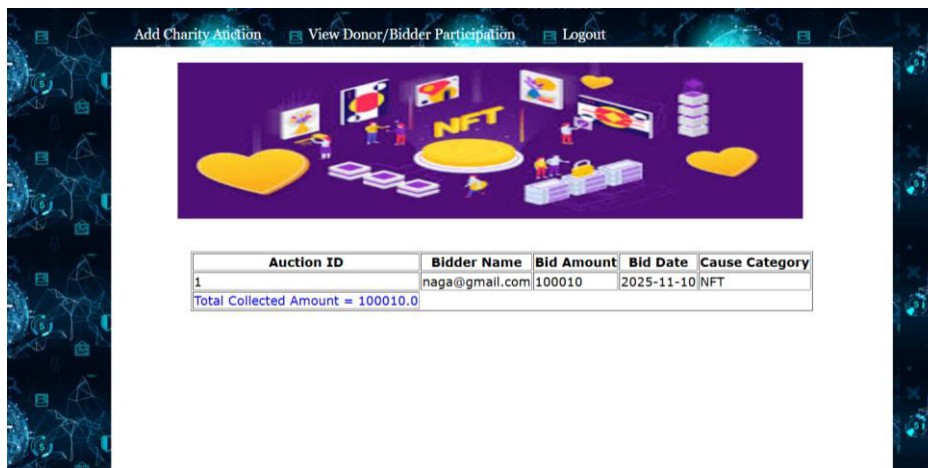


Figure 5: View donor/bidder participation table for auction id 1.

Figure 5 depicts the donor and bidder participation table after successful bidding for a specific auction. It displays recorded bid details along with total collected funds. All entries are retrieved directly from the blockchain ledger, ensuring data integrity. This view enables transparent verification of fundraising outcomes. The figure concludes the end-to-end lifecycle of NFT-based charity auctions.

5.CONCLUSION

This research marks a significant step toward utilizing blockchain technology to revolutionize charitable donations, as evidenced by its Django-based framework and the detailed functionalities. The platform effectively integrates a local blockchain, likely Ganache, with a smart contract deployed at enabling secure user registration, auction creation, bidding, and participation tracking, with transaction receipts providing undeniable proof of immutability. The consistent user interface, featuring a cyan/teal background and purple NFT-themed banner, ensures brand recognition across all stages, from the homepage to the bidder dashboard, while the role-based flow catering to auctioneers and bidders demonstrates thoughtful design. However, the research faces challenges that impact its performance, including reliance which pose concurrency issues, and the lack of real-time data refreshes, as seen with expired bid dates on the current date. Security remains a concern with plaintext password storage and the absence of input validation or Cross-Site Request Forgery (CSRF) protection, while the local blockchain setup limits scalability compared to a test net deployment. Performance can be significantly enhanced by adopting Django's ORM or session management for state handling, implementing dynamic blockchain updates to prevent stale data, and optimizing smart contract gas usage with event emissions. Furthermore, integrating a payment gateway to utilize the card/CVV fields and adding robust error handling for Web3 interactions will improve reliability. The platform's transparency and role-specific functionalities lay a strong foundation, but addressing these performance bottlenecks will be crucial for real-world adoption.

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