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NFTeller: Dual Centric Visual Analytics of NFT Transactions

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***Abstract*—Non-fungible tokens (NFTs) can certify the authenticity and scarcity of digital assets on the blockchain. There is an urgent need to identify impact attributes from various potential factors and further evaluate NFT collectibles. Nevertheless, the task is challenging due to the massive amount of heterogeneous and multi-modal data (e.g., social media text, numerical transaction data, and images) in NFT transactions. To this end, we present an interactive visual analytics system, *NFTeller*, that provides a dual-centric perspective analysis of NFT transactions. The system i) summarizes the temporal evolution and correlation of transaction patterns and dynamic impact attributes of NFT collection projects; ii) presents an augmented chord diagram with a radial stacked bar chart for exploring the co-collected projects and co-occurring whale accounts. We derive in-depth insights from case studies on a real data set to evaluate the systems' effectiveness and usability.**

***Index Terms*—Non-fungible tokens (NFTs), Blockchain, Visual analytics**

I. Introduction

NFTs are non-interchangeable units of data stored on the blockchain, which are minted and verified automatically by smart contracts [1]. NFTs can bind with any digital properties to prove their authenticity and scarcity [2], which motivates the development of NFT marketplaces (e.g., OpenSea [3] and SuperRare [4]). Among all categories of NFT-tied assets, NFT collectibles take over a significant market share with enormous transaction volumes [5]. Nevertheless, diversified potential impact attributes (e.g., social media communication effects, visual scarcity, and whale accounts' behaviors) have caused challenges for stakeholders (e.g., investors, collectors, and brokers) to evaluate NFT collectibles efficiently.

To address the challenges, we firstly identify a comprehensive impact attributes analysis framework (Table I) when evaluating NFT collectibles: i) *static* visual features that determine the scarcity degree of an individual NFT collectible [6]; ii) *dynamic* social media communication effects; and iii) *dynamic* transaction behaviors of whale accounts (i.e., individuals or entities that hold large amounts of cryptocurrencies). Accordingly, we propose an interactive visualization system named *NFTeller* to flexibly fulfill dual-centric analysis workflows for the target users of investors, collectors, and brokers in current NFT marketplaces. We conduct three case studies on a real data set to evaluate the system and derive valuable insights.

TABLE I
Mapping visual design of *NFTeller* from impact attributes, data, analysis tasks, and system views

Impact Attributes	
Visual features	*Style category*: the aesthetic style of individual NFT projects. *Visual scarcity*: within-collection uniqueness of NFT collectibles.
Communication effects	*Popularity*: attention got on social media. *Sentiment polarity*: negative, positive, and neutral distribution.
Whale accounts' behaviors	*Transaction activities*: NFT transactions among whale accounts. *Co-collection preference*: co-collected NFTs by whale accounts.

II. Visual Analytics System

The *NFTeller* (Fig. 1) interface comprises five well-coordinated views and supports dual-centric analysis. For *NFT collection projects*, the market share view (A1) and project ranking view (A2) present the basic information of individual projects. The attribute analysis view (B) displays both the development patterns of NFT marketplaces and individual projects to analyze the correlation of dynamic impact attributes. For *whale accounts*, the whale account co-collection view (C) leverages an augmented chord diagram with a radial stacked bar chart to depict the set relations between whale accounts and projects. The scarcity analysis view (D) utilizes multi-variate glyphs (Fig. 2) to simultaneously encode NFT collectibles' images, prices, and the scarcity scores owned by one specific whale account to illustrate the co-collection preference of whale accounts.

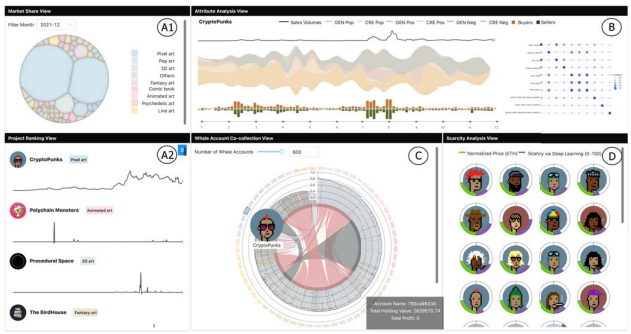

Fig. 1. The system interface.

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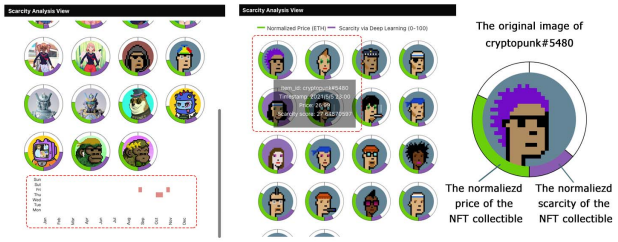
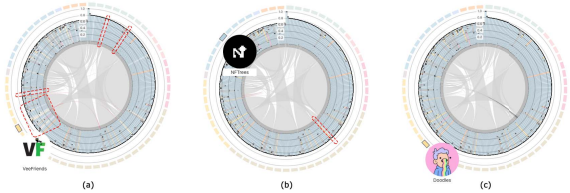


(a) The exhibition of NFT collectibles (b) The glyph composition

Fig. 2. The scarcity analysis view and multi-variate glyphs.

III. Case Studies

Case 1: Find prospective NFT collection projects. With the soaring exchange rate of cryptocurrencies and costly service fees, investing in NFT marketplaces could generate huge financial barriers. In this study, we use *NFTeller* for seeking out prospective NFT collection projects based on the previous patterns of the market evolution. As shown in Fig. 3, the dual-centric whale account co-collection view illustrates every individual NFT project's transaction frequency and co-occurring whale accounts through the radial stacked bar chart and chord diagram. When having potential prospective NFT project candidates, users could easily make comparisons and identify NFT projects with the most co-occurring whale accounts or the highest transaction frequency. Thus they can quickly select some prospective projects.



(a) (b) (c)

Fig. 3. Compare co-collection views to find prospective NFT projects.

Case 2: Distinguish luxury from fast-moving NFTs. Similar to other retail goods, NFT collectibles could be differentiated between "luxuries" and "fast-moving" ones. *NFTeller* could be used to distinguish these two categories.

By hypothesis, the most frequently highlighted projects tend to get superior reliability than other projects. We use the whale account co-collection view and attribute analysis view to verify this statement. Take one blue-chip NFT project, CryptoPunks, as an example (Fig. 4). Its sales volumes are relatively independent of social media communication effects, implying that the "luxuries" category is not prone to short-term social media promotion activities.

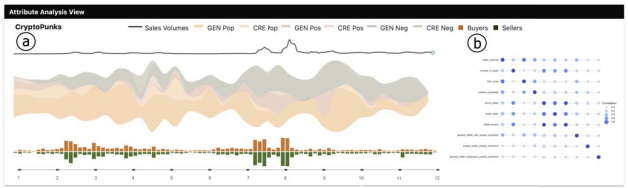


Fig. 4. Distinguish luxury from fast-moving NFTs by attribute analysis view.

Case 3: Select opportune moment for investment. *NFTeller* could also be used to find the proper investment timing by monitoring sales volume trends, social media communication effects, and whale accounts behaviors. As Fig. 5 displays, social media popularity is positively correlated with sales volumes and floor price. However, the market share of NFT collection projects that only had one peak would gradually decrease and attract very limited whale accounts. In contrast, projects whose attributes' evolution illustrated regular fluctuations had a longer market life cycle. Thus, it would be better to "procrastinate" a little bit and wait for the next climax on social media as the indicator of investment.

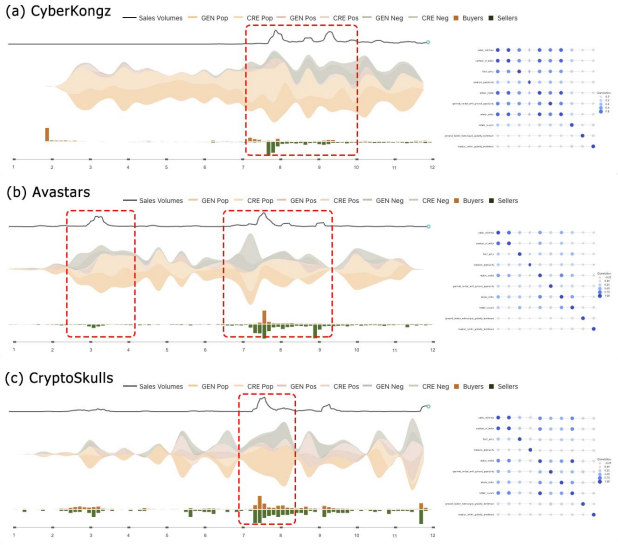


Fig. 5. Monitor the evolution of NFT collection projects for timing selection.

IV. Conclusion

In this work, we propose an interactive visual analytics system, *NFTeller* to assist our target users in evaluating NFT collectibles. We characterized one static impact attribute and two dynamic attributes out of various potential factors in collaboration with domain experts. Accordingly, we developed *NFTeller* with five well-coordinated views and flexible interactions to fulfill a dual-centric perspective analysis of NFT transactions. Further, we validated the effectiveness and usability of our system via three insightful case studies. The results indicated that *NFTeller* performs efficiently in detecting NFT marketplaces patterns and evaluating NFT collectibles.

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