

Construction and Empirical Analysis of NFT Digital Art Market Value Prediction Model

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Abstract: The purpose of this article is to build and verify an effective market value prediction model of NFT digital art and make an empirical analysis to cope with the growing demand and uncertainty of NFT market. Through the comprehensive application of data collection, preprocessing, neural network model construction and optimization, the market value of NFT digital works of art is deeply explored in this article. In the research process, firstly, a large number of transaction data are collected from the open NFT trading platform, and strict data cleaning and feature selection are carried out; Then, a prediction model is built based on CNN (Convolutional Neural Network) model, and the model is optimized by cross-validation and parameter adjustment. The experimental results show that the model has high prediction accuracy and reliability, and can capture the key influencing factors of NFT digital art market value, such as artist reputation, scarcity of works and market demand, and point out the importance of the key influencing factors. At the same time, based on the research results, this article puts forward policy suggestions and practical enlightenment for NFT digital art market participants and regulators, with a view to promoting the healthy development of the market.

Keywords: NFT digital artwork, Market value forecast, Convolutional Neural Network model, Key influencing factors, Policy advice.

1. Introduction

In recent years, with the rapid development of blockchain technology, NFT (non-fungible token), as a new form of digital assets, has risen rapidly around the world [1]. NFT, with its unique characteristics of uniqueness, indivisibility and traceability, provides a brand-new solution for the proof of ownership and value exchange of digital content [2]. Especially in the digital art market, the application of NFT has set off a revolution, which enables digital art to be collected and traded like physical art, and gives them unprecedented economic value and cultural significance [3]. However, the price of NFT digital art market fluctuates greatly, and its value evaluation has become a complex and key issue [4]. Therefore, the research on the forecasting method of NFT digital art market value not only has important guiding significance for investors, but also has far-reaching influence on the healthy development of the whole digital art market.

The purpose of this article is to build an effective market value prediction model of NFT digital art, so as to realize the accurate prediction of the market value of NFT digital art. The research scope will cover all aspects of NFT digital art market, including market status, trading mechanism and value evaluation. The main contents include the analysis of influencing factors of NFT digital art market value, the construction and verification of forecasting model and empirical research.

2. Overview of NFT Digital Art Market

2.1. Basic Concepts of NFT

NFT is a digital asset based on blockchain technology, which has the characteristics of uniqueness, indivisibility and traceability. Each NFT represents a unique digital project, such as digital artwork, music, video, etc., and its ownership and transaction history can be publicly verified [5]. In the blockchain technology, NFT realizes the proof of ownership

and value exchange of digital content through smart contracts, which provides a new solution for copyright protection and value evaluation of digital assets [6].

2.2. The Current Development Status of The Digital Art Market

With the popularization of the Internet and the acceleration of the digitalization process, the digital art market shows a rapid growth trend. At present, the digital art market has formed a certain scale, and a number of well-known trading platforms have emerged, such as OpenSea and Rarible [7]. These platforms provide a convenient way for the creation, exhibition and trading of digital works of art, attracting a large number of artists and collectors to participate. At the same time, the user characteristics of the digital art market are also showing a trend of youthfulness and specialization, which has injected new vitality into the sustainable development of the market.

2.3. The Application of NFT in the Digital Art Market

The application of NFT in the digital art market is mainly reflected in the following aspects: first, NFT provides a unique proof of ownership for digital art, which enables digital art to be collected and traded like physical art; Secondly, the traceability of NFT enables the transaction history of digital works of art to be publicly verified, which increases the transparency and credibility of the transaction; Finally, NFT also provides a new solution for the copyright protection of digital works of art, which makes the rights and interests of artists better protected. These applications make NFT play an important role in the digital art market and promote the rapid development of the market [8].

2.4. Influencing Factors of Market Value

There are many factors affecting the market value of NFT digital art, including the reputation of artists, the scarcity of

works, market demand, etc. Artist's reputation is one of the important factors affecting the value of NFT digital works of art, and the works of well-known artists often have higher market value and collection value. The scarcity of works is also a key factor affecting the value of NFT digital works of art, and scarce works are often sought after by collectors [10]. In addition, the market demand is also an important factor affecting the value of NFT digital works of art. When the market demand increases, the value of works will also increase accordingly. Therefore, when constructing the market value prediction model of NFT digital art, we need to fully consider the influence of these factors.

3. Market Value Prediction Model of NFT Digital Art

3.1. Data Collection and Pretreatment

Data collection is the first step of model construction. The data of this study mainly comes from open NFT trading platforms, including OpenSea and Rarible. Through API interface or web crawler technology, this article collects a large number of NFT digital art transaction data, including key information such as the name, artist, creation time, transaction price, transaction volume and so on.

In the stage of data cleaning, this article first removes duplicate, missing or abnormal data records to ensure the integrity and accuracy of data; Then, the data are standardized to eliminate the differences between different dimensional features and improve the generalization ability of the model. In addition, this article also makes feature selection.

According to domain knowledge and statistical analysis, the features that have a significant impact on the market value of NFT digital artworks are selected as input variables of the model, including artist reputation, work scarcity and market demand.

3.2. Model Selection and Construction Steps

In the aspect of model selection, this article comprehensively considers the advantages and disadvantages of various forecasting methods, and finally chooses CNN model as the main forecasting tool in this study. CNN model has strong nonlinear fitting ability and self-adaptability, and can capture complex patterns and potential laws in data, which is suitable for dealing with highly uncertain and complex forecasting problems such as the market value of NFT digital artworks. According to the specific needs of NFT digital art market value prediction, we can choose a suitable CNN structure and set and optimize the corresponding parameters.

The concrete steps of model construction include variable definition, model hypothesis, parameter estimation and so on. Firstly, according to the results of data cleaning and feature selection, this article defines the input variables and output variables of the model. Input variables mainly include artist's reputation, scarcity of works, market demand and other characteristics, while output variables are the market value of NFT digital works of art. Then, according to the theoretical basis of CNN model, this article constructs the corresponding model structure (as shown in Figure 1) and initializes the parameters.

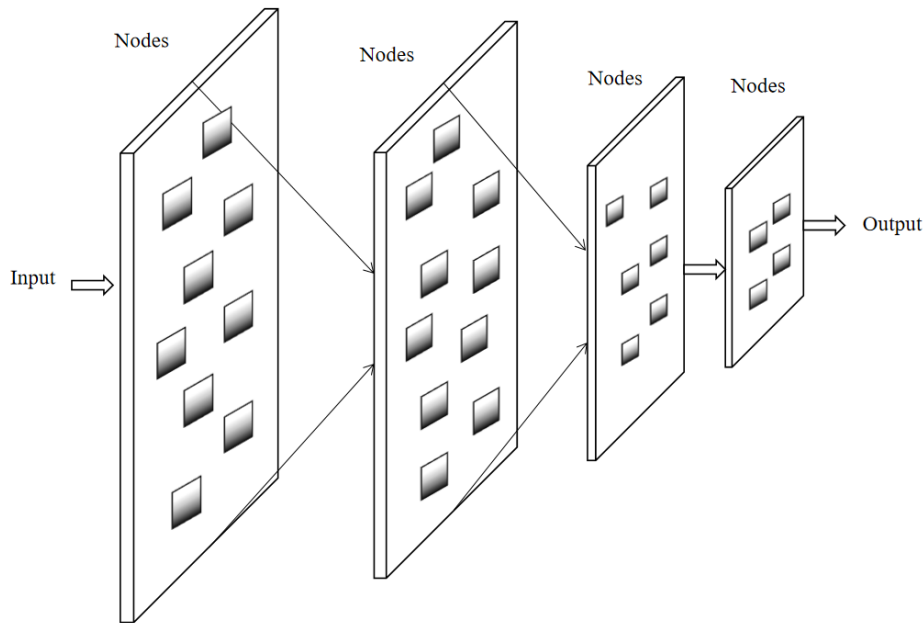


Figure 1. CNN structure

Suppose there is a function F representing CNN model, which maps the feature X of NFT digital artwork to its market value Y . This function can be expressed as:

$$Y = F(X; \theta) + \varepsilon \quad (1)$$

Where θ is the parameter of the model and ε is the prediction error.

In order to measure the prediction error of the model, a loss function L - mean square error is defined:

$$L(\theta) = \frac{1}{2N} \sum_{i=1}^N (F(X_i; \theta) - Y_i)^2 \quad (2)$$

Among them, N is the number of samples, and X_i and Y_i are the characteristics and real market value of the i sample respectively.

In the aspect of model hypothesis, this article assumes that there is a nonlinear relationship between the market value of NFT digital works of art and its characteristics, and this

relationship can be fitted by CNN model. In the parameter estimation stage, the back propagation algorithm and gradient descent method are used to optimize the parameters of the model, and the parameter updating formula is:

$$\theta_l^{(t+1)} = \theta_l^{(t)} - \alpha \cdot \frac{\partial L}{\partial \theta_l} \quad (3)$$

Where $\theta_l^{(t)}$ is the parameter of the l layer in the t iteration and α is the learning rate.

Through repeated iterative training, we get a convergent CNN model to predict the market value of NFT digital works of art. In addition, in order to improve the prediction performance of the model, cross-validation and parameter adjustment are adopted to optimize the model. Cross-validation is a technique to evaluate the performance of the model. By dividing the data set into training set and validation set, we can evaluate the performance of the model on different

data sets and select the model parameters with the best performance.

4. Empirical Analysis

4.1. Sample Description

This study selects the NFT digital art transaction data in a certain period as a sample, covering many types of digital art, such as digital paintings, digital sculptures, digital music and so on. The price distribution of sample data shows great differences, ranging from several hundred yuan to several million yuan, reflecting the diversity and complexity of NFT digital art market.

4.2. Prediction Result Display

Using the CNN model to predict the sample data, we get the predicted market value of each NFT digital art, as shown in Figure 2:

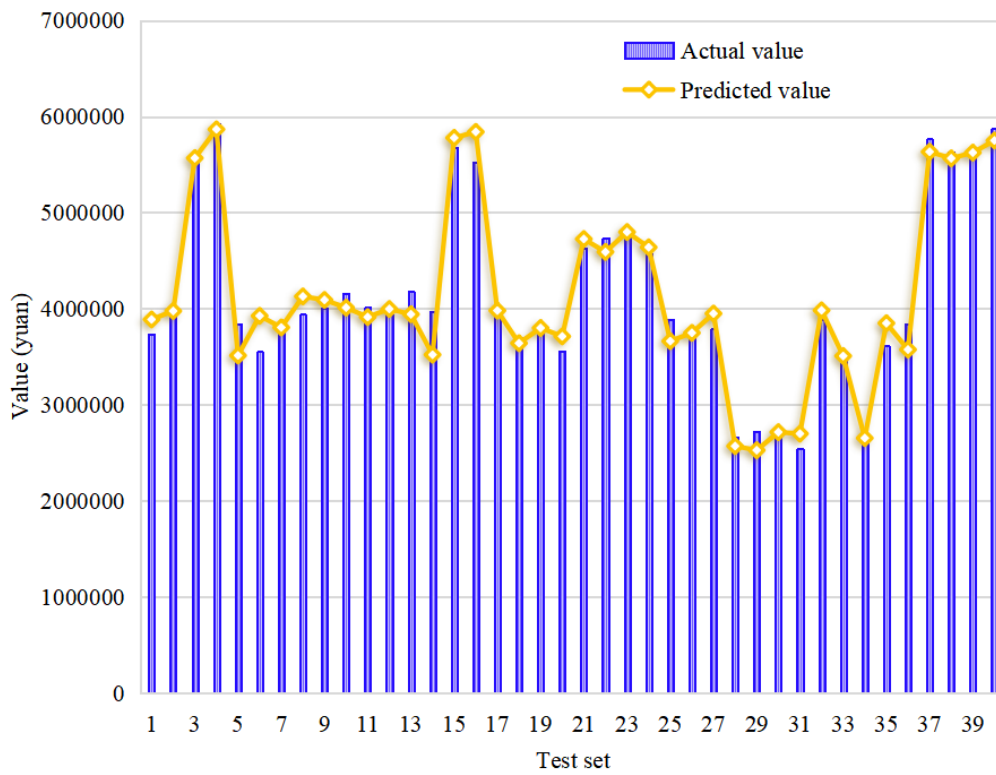


Figure 2. Model prediction error

Compared with the actual market value, it can be found that the prediction results of the model have high accuracy and credibility. The error between the predicted value and the actual value is small, and most of the predicted values fall within the reasonable range of the actual value. This shows that the CNN model constructed in this article is excellent in predicting the market value of NFT digital art, with high accuracy and credibility, which provides strong support for

the analysis and decision-making of NFT market.

4.3. Sensitivity analysis

In order to explore the influence of different factors on the prediction results, this article carries out sensitivity analysis. By changing the values of the input variables, we can observe the changes of the prediction results, as shown in Table 1:

Table 1. Sensitivity Analysis Table for Predicting the Market Value of NFT Digital Artworks

Input Variable	Original Value	Changed Value 1	Prediction Change 1	Changed Value 2	Prediction Change 2	Sensitivity Analysis Notes
Artist Reputation	8	6	-10%	10	+15%	Significant Impact
Work Scarcity	7	5	-12%	9	+18%	Significant Impact
Market Demand	9	6	-15%	12	+20%	Significant Impact
Work Creativity	6	4	-5%	8	+10%	Special Factor, Mild Impact
Artist's Personal Style	7	5	-3%	9	+7%	Special Factor, Mild to Moderate Impact

Note: The values in the table represent the relative influence degree of each factor in sensitivity analysis. The change of forecast results is expressed as a percentage, which is relative to the increase or decrease of the original forecast value. The remarks column of sensitivity analysis shows the influence of various factors on the prediction results.

The results show that the artist's reputation, the scarcity of works and the market demand have significant influence on the prediction results. When these factors change, the prediction results will change accordingly, which verifies the robustness and sensitivity of the model. At the same time, this article also found some special factors that affect the market value of NFT digital art, such as the creativity of works and the artist's personal style, which can be further considered and incorporated into the model in future research.

5. Conclusions

In this article, a series of in-depth studies are carried out around the market value prediction of NFT digital art. By constructing a prediction model based on CNN, this article successfully realizes the accurate prediction of the market value of NFT digital art. The experimental results show that the model has high prediction accuracy and stability, and can effectively capture the key influencing factors of market value. Specifically, this article finds that factors such as artist's reputation, scarcity of works, market demand, creativity of works and artist's personal style have a significant impact on the market value of NFT digital works of art. These research results not only verify the effectiveness of the model, but also provide an important reference for participants in the NFT digital art market.

Based on the research results of this article, this article puts forward the following suggestions for NFT digital art market participants and regulators:

To enhance market efficiency, we ought to prioritize fostering and elevating artists' reputations while also considering the rarity of their works and the fluidity of market demand, thereby enabling the formulation of sound pricing strategies. In addition, the creativity of works and the artist's personal style are also important factors to enhance the

market value, so innovation and personalized development should be encouraged.

For regulators, we should strengthen the supervision of NFT digital art market, standardize the market order, and prevent malicious speculation and fraud. At the same time, a perfect market information disclosure system should be established to improve market transparency and provide a fair and equitable trading environment for market participants.

References

- [1] Hd A T P, Davis J. NON-FUNGIBLE TOKEN(NFT) – THE GAME CHANGER IN THE DIGITAL ART WORLD [J]. *Ciencia Y Sociedad*, 2021, 51(1):190-194.
- [2] Li Tianyi. The marginal exploration of NFT market products of Dunhuang digital artworks [J]. *China National Expo*, 2023(14):53-55.
- [3] Zhang Huibin, Zhang Qi. NFT Art: New Form of Digital Art and Copyrights [J]. *Science and Technology and Law*, 2022, (03):42-50.
- [4] Feng Baifan, Tai Ziyue. Limitations and prospects: phased observation of digital art and NFT art market [J]. *Contemporary artists*, 2022, (02):30-33.
- [5] Liu Shuangzhou, Guo Zhiwei. The application risk and prevention of NFT in the digital art market [J]. *Art Management*, 2022(1):113-119.
- [6] Liu Shiqi, Hu Yushu, Liu Yongjian, et al. Inheritance and development of Tibetan cultural digital artworks in NFT era [J]. *Tibet Science and Technology*, 2022, (08):31-35.
- [7] Liu Da, Fan Fan. Analysis of the commercial value of NFT encrypted digital works of art [J]. *China Business Theory*, 2022(16):128-130.
- [8] Song Fangbin, Gan Feng. The risk and dual protection mode of NFT artworks [J]. *Nanjing Social Sciences*, 2022(8):152-160.
- [9] Zhang Yixuan, Xiang Yong. The value negotiation mode of NFT artworks in the meta-universe field [J]. *review of industrial economics*, 2023(1):124-135.
- [10] Yang Qing. The trend and digital transformation of the art market in the epidemic economy [J]. *Art Market*, 2023(2):69-71.