Artval Exchange Platform
White Paper

[v0.7]

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1. Preface

From the 15th to the 17th centuries, European fleets roamed the Earth's ocean in search of new trade routes and exchange partners. Thus began the Age of Discovery.

2016 has been called the "Year of Blockchain", as countless engineers began exploring routes on the Internet of Value in search of a dream of the "One Chain". We believe that this great voyage will continue into the digital world.

Blockchain has given every ordinary person the right and hope to dream, and fulfills its value in each line of code. It is driven by a collapse of trust in traditional authority, defiance of experts, and confidence in a new authority. This new authority is the authority of the internet. The most adamant Bitcoin disciples view Bitcoin's value and future as a faith. Since it is a type of faith, it has no relation to the logic of traditional finance. What is revolutionary about blockchain isn't just its technology, it is the spirit of openness, transparency, and trust that drives it. This spirit is then used to think about what changes it can bring to commercial models, and what significant applicable results it can have on the industry.

The development of art has always required both social and monetary support. Prior to the 14th century, artists mainly created with support from the papacy. From the 14th century to the 16th century, the Renaissance moved art from the hands of God to the hands of Man and imbued it with personality. Beginning with the Venetian school in the 16th century, artists gave the broader bourgeois a voice in art, infusing it with even more vitality. In 18th century post-industrial revolution London, Claude Monet painted "Impression, Sunrise". After the USA's digital revolution, the world was strangely cast in the light of Andy Warhol's silk-screen portraits. The appearance of blockchain technology has brought about art's next opportunity for metamorphosis, and created a new atmosphere in the art world. Only by bringing art to broader audiences can art truly have its value and freedom restored.

Our project, Artval, takes its name from "art value", and is aimed at establishing an art value exchange platform. Using blockchain technology, Artval begins with the digital registration, pricing, exchange, and intellectual property rights marketing of pieces of art, thus reconstructing a fair market environment for artists. This allows pieces of art to rapidly circulate and continually increase in value, completely destabilizing traditional art markets. Artval brings freedom back to the artists, and brings value back to art.

2. About Blockchain

On November 1, 2008, a person named Satoshi Nakamoto published a thesis paper to an unknown cryptography group [1]. This thesis paper described his design of a digital currency named Bitcoin. He left behind very little information online, and almost nobody had heard of him. Satoshi himself might have been a mystery, but his design solved a major decades-old problem in the cryptoanalysis world. This digital currency was easy to use and difficult to track. It was out of the control of governments and banks, a concept that has always been popular on the internet.

Bitcoin uses a distributed, open ledger to eliminate third-party management, which Satoshi originally called a "chain of blocks". Users were happy to use their computer's CPU to operate a special software used for "mining", and formed a blockchain jointly maintained by the internet. However, after several years of growth, people discovered that its potential was not limited to digital currency alone. In October, 2015, US-based "The Economist" published a cover story titled *The Trust Machine*. Everyone realized that the value of the blockchain driving Bitcoin's underlying technology was actually more valuable than Bitcoin itself.

Blockchain technology can be used for a variety of applications, with one thing in common between them: decentralization. Decentralized apps are any app that has the following traits [2]:

- They must be completely open-source and autonomously operated. They can't be manipulated by any central group or institution. Improvements can be made to respond to market needs, but these improvements must be approved by all users.

- Data must be securely, publicly, redundantly stored in a distributed network to prevent falsification and single points of failure.

- Application visitors must expend tokens, while application contributors can get tokens as rewards.

- The application must use an algorithm with value certification to generate tokens.

Bitcoin introduced blockchain technology, but Bitcoin itself was just the most successful application of blockchain technology in the financial sector. It didn't have many ways to develop decentralized applications on top of this. And so in early 2015, the first version of Ethereum was released. Ethereum is a decentralized blockchain

application development platform [3], which mainly improved on Bitcoin's blockchain by introducing smart contracts with Turing completeness. Developers can write smart contract code to implement the business logic of the industry, which has opened a door for decentralized application lovers around the world.

In reality, with the assurance of a consensus mechanism, participants in the blockchain system maintain the updates of the same ledger with strict rules and consensus checks; add to that blockchain's decentralized and un-tamperable traits, and these things can be seen to have built the cornerstone of trust. Smart contracts' autonomous supervision has reduced segments of supervision, auditing, and verification, thereby reducing the contract's cost, improving efficacy of contract implementation, and effectively transferring value. It has allowed people to transfer value online just as conveniently and cheaply as transferring information.

3. Art Industry Analysis

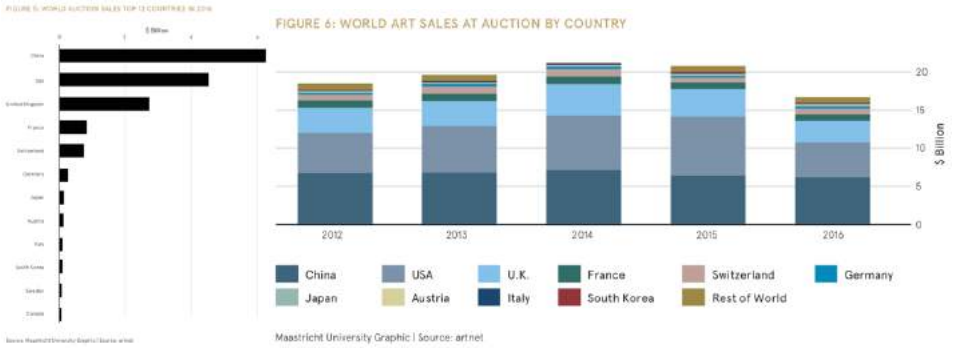
3.1 Market Scope

According to the latest TEFAF 2017 global market report [4], in 2016 alone global art market sales totaled over US$45 billion. European and American art market trades accounted for 80% of the total, of which 29.5% were from the U.S. and 24% were from the UK, while China accounted for 18% of the global trade total. The art auction market had a total global sales of US$16.9 billion, with Europe and America accounting for more than 55%, a generally reduced average price per piece, and growing market scope. For dealers, reputation, transparency, and work ethic are increasingly important.

The price distribution of the European and American art market has taken on trends of polarized differentiation. Looking at the number of trades, low-price pieces guide the general market. Trade of pieces of art under US$10,000 accounts for nearly 90% of all trades, while trades of art pieces over US$10,000 account for just 2% of all trades. When it comes to trade total, the market is guided by high-price auction pieces. In 2015, 57% of total sales were pieces sold for over US$1 million, and accounted for 1% of total trades. 28% of total sales were pieces sold for over US$10 million, but those only accounted for 0.1% of total trades. Growth of auction pieces over US$1 million was greater than other groups.

As for types of art, paintings are the mainstream trade product. In the past decade, the distribution of paintings in the Euro-American market has been 73%, followed by sculptures and drawings, which have accounted for 12% and 9% respectively.

China's auction market has remained similar to how it was in early 2015. Despite falling 2.6%, China's 2016 sales total was US$6.33 billion, giving it the largest sales total in the world.



In addition, based on Barclays' recommendation data, institutional investors and high-end clients will allocate 5% of their assets to invest in art. According to this estimate, the Chinese art market's potential demand is over six trillion yuan, but is currently only at a scale of hundreds of billions of yuan.

3.2 Differences Between Chinese and Western Markets

- **Differences in Education Systems**

  The Western market's operation is fairly healthy and mature. Typically, a young artist is signed by a gallery, which then takes care of the artist's living expenses and formulates a comprehensive promotional plan for the artist. All the artist needs to do is focus on creating. After 5-10 years of sponsorship, the artist

gradually develops a circle of collectors, and only then are their pieces auctioned off in second-tier markets, as the artists gradually builds up the value of their art.

The issue of China's art market is that its galleries are focused on short-term profits, but are sapped by taxes, so are unwilling to invest time and money into an artist. Artists sign agreements as temporary workers, which allows artists to display their work in galleries for one year or even just a few months. Galleries are unwilling to invest in promotion, and won't formulate any sort of cultivation plan for artists. They also sign several artists at once, so they can't focus on cultivating just one. Essentially, many Chinese galleries aren't really agencies. Also, when some Chinese artists sign with galleries, they will also sell their paintings to others at low prices and severely disrupt the market. Galleries being unwilling to cultivate an artist over time and artists being unwilling to stick to their word created a vicious cycle which in turn produced the current situation. Of course, some galleries have been brave enough to emulate the Western system, but they are still encountering difficulties.

- **Differences in Audience Groups**

In mainland China, local pieces of art like calligraphy, paintings, porcelain, jade pieces, and curio objects are directed at a Chinese audience. Foreign collectors might like Chinese porcelain and jade, but might not pay much attention to Chinese calligraphy and paintings. Thus, the flow of Chinese art mainly circulates around China, and isn't sufficiently attractive to draw foreign markets.

However, Western pieces of art are much more highly recognized, and have a wider circulation. Chinese elementary school students know about Vincent van Gogh and Pablo Picasso, but almost no foreign children of the same age know about Qi Baishi. Because of this, when it comes to the global art market, Chinese art has a fairly limited audience.

- **Common Pains**

Artists have a hard time finding a fair market environment, both in the West and in China. The right to set prices is controlled by an elite few, and it is hard for a lesser-known artist to maintain a normal life based on exchange art alone. Chinese trade data has a major issue with falsified transactions, and although the West has fairly reliable trade data, trade data can only reflect the prices of artists' pieces that have already been traded. Artists who haven't entered the exchange market don't have a fair system to set prices.

3.3 Chinese Market Issues

- **Distorted Pricing Mechanisms**

In the Chinese market, since galleries and auction houses began around the same time and only have a total history of roughly twenty years, galleries with relatively little capital are pitted against capital-rich auction companies. China's art market skipped the first tier and headed straight for the second tier. This is a very unhealthy phenomenon, and it led to a great deal of power consolidated in auction houses, which then began hyping up pieces of art as speculative investment opportunities for Chines people. China's art investment is the same as stock investment: they are both short-term speculative investments. But foreign art is a longer-term investment for greater profits. Since "insiders" control the art market and direction of art pieces, they set prices so "outsiders" can't afford the art, leaving true art-loving collectors to foot the bill. A few manipulate the system to their own benefit, while real buyers become victims. Everyone is mainly concerned with the fame and titles of an artist, as well as their position and organization. The lack of transparency in the market also causes the pricing of the entire art market to be distorted.

- **Difficult Realization, Unequal Distribution**

As people overemphasize celebrity status and appreciation for the art itself declines, space for lower-level and emerging artists to grow has become scarcely small. It's as if seeking fame is the only choice left, but the road to fame is messy and warped, as the wealthy are extravagantly wealthy and the poor are dirt poor. Artists who should be concentrating on creation and art are forced by life to pour all their efforts into becoming famous, a situation which directly results in lower quality art.

- **Lack of Social Credibility**

Motivated by profits and lack of supervision, industry operators and enterprises have formed and conformed to industry rules, and issues of fake art, fake trades, and fake auctions are becoming increasingly rampant. The loss of credibility and breaking of heritage has made it so ordinary consumers without a professional appraisal ability have a hard time telling if a piece of art is real or fake. This has become the biggest obstacle for new consumers entering the market. There is a widespread forgery problem, with forgery issues existing in 70-75% of the one billion yearly trades. There are no objective standards for art

appraisal, so appraisers often have difficulty judging. Even worse, some experts deliberately make incorrect appraisals for their own profit. In addition, forgery techniques and technology are improving, with Giclée, non-halftone dot printing, high-quality imitation, robotic arms, and other methods, all of which have become the greatest obstacles in restricting trade of calligraphy and painting art. The rapidly-growing market has attracted a great deal of funds, but at the same time has also lured some investors to seek profit with illegal behavior. This wave of forgery has continued to grow, and fakes have been hard for investors to guard against. With their monopoly on the market and centralized framework, some auction houses have turned a blind eye to the influx of fakes in order to increase their own profits. They have forsaken their commercial credibility and ignored interests of investors.

- **Lack of Appraisal Methods**

  Due to disputes over pieces' authenticity and origins, refusal to pay and compensation claims are common occurrences. Authorization systems also lack transparency, an example of which is using paper certificates like endorsement permits to manufacture scarcity. But this method also destroys the traits that digital art requires, like how it should be broadcast around the world in order to prove the veracity of digital signatures. The ambiguity of art pieces has also made it more difficult to track them and prevent fraud.

4. The Value of Artval

4.1 Exploration of the Internet Age

In the past, people made many attempts to infuse new vitality into the art exchange market and protect the interests of original artists. In recent years, people have tried to use the e-commerce model which achieved massive success in the Internet Age to improve the mobility of art [5-7], but with little effect. Even though entrepreneurs made the great slogan of "bring art into every middle-class home", no matter how low they have kept prices of art, the middle class hasn't "taken the bait". The reason might be that the vast middle class doesn't understand the evaluation of art, and lack of social credibility has brought about a prevalence of fakes. Even if the middle class wanted to bring more art into their lives, they would be hard-pressed to accurately evaluate how much they should pay for a piece of art.

People have also tried art financing methods, with art funds, art trusts, bonded art, art "mortgages", art banks, art indexes, and culture assets and equity exchanges, in a sea of dazzling art financing derivatives. Although the route of art financing is still in its trial phase, several issues have already been revealed. There is the case of the "sharefying" of Chinese art [8], to which one can't help but say: "Art Financial Products: It's Hard to Love You" [9]. Based on our analysis, one of the most important reasons for this is that art financing has become completely uncoupled from the value of art, and is just a simplistic financial tool being tied to a piece of art, turning that piece of art into a tool for speculation.

4.2 What Blockchain Offers

The technological traits of blockchain are: decentralization, un-tamperability, openness, transparency, traceability, and no trust requirements. Blockchain can be used to establish a value chain of art trades. As soon as a piece of art enters the blockchain, anti-counterfeiting appraisal information about the piece will be logged on the blockchain, which will never be able to be tampered with, and will be searchable by anyone. When a piece is circulating, the blockchain will log every origin and destination, confirming the current possessor of the piece. The art pieces will use blockchain tokens as the medium of settling the transaction, and a smart contract will automatically apply market rules in an open, transparent, real-time, efficient manner. Smart contracts are an open computing algorithm that are voted on by the public. The added value of art pieces during their circulation will be automatically distributed by the smart contract based on pre-defined rules.

The precondition for confirming an art piece's value is that it can go into an ordinary family's home. With the decentralization of blockchain, we can establish a price setting platform for art that isn't manipulated by a small number of people, and concentrates the wisdom of the public. The more people participating in the price setting platform, the better the price consensus of a piece of art will be on the market. In the end, the confirmed price will reflect the opinion of the majority of people in the market, making it closer to a truly reasonable price. An effective price discovery mechanism will lay the foundation for market liquidity of vast numbers of art pieces. Aside from the masterpieces at the top of the pyramid, the pieces of a broader group of artists will be able to flow into the market. This would have been impossible in the past, without blockchain's establishment of trust.

Blockchain has created a world of the Internet of Value that runs parallel with the real world [10]. After art pieces are registered on the blockchain, they become a

digital asset that can freely flow on the Internet of Value, so that pieces of art can be traded in a broader world. This will majorly increase the speed of a piece of art's liquidity, cause the art market to flourish, and at the same time guarantee the actual price of the piece of art.

4.3 The Traditional Market vs. Artval

Compared to the problems that the traditional art market has, Artval provides the following value:

	Traditional Art Market	**Artval**
Pricing	Set by a small number of people, art is now over-and-uneven-priced. Buyers do not believe art market, and they are afraid to make purchases	Crowd-sourced valuing to make the price transparent Buyers believer the market and they can drive the market higher
Polarizing	By buying out some artists and manipulating the market, the merchants escalated the income polarizing problem	Fair, just and open Any piece of art has the opportunity to emerge on the market
Uneven Distribution	Institutions get a lot of money by hyping up the artists. Yet the artists themselves do not get the same payoff	The artists get appropriate remuneration, after each transaction
Single Structure	The traditional exchange methods are designed for the value growth of the original piece of art, but the value of copyright has yet to be developed	Copyright is treated as a separate piece of art and it is linked to the original work

4.4 Who We Help

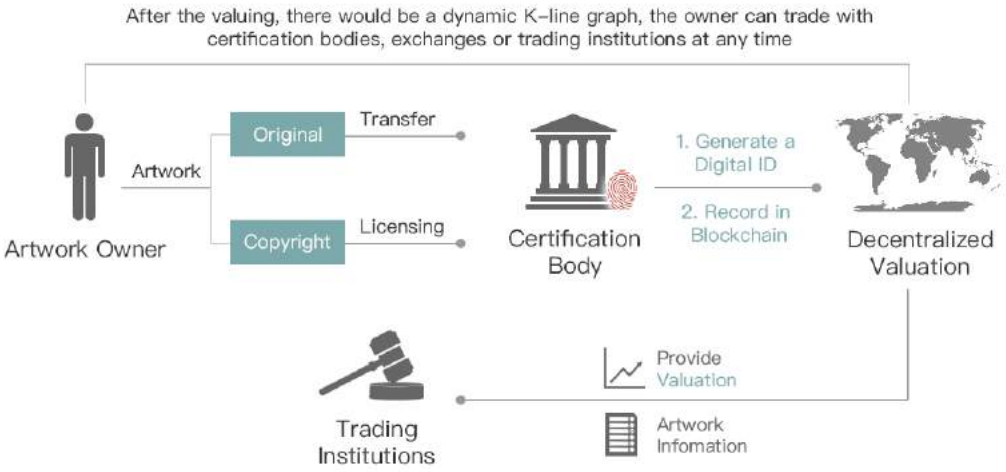
The "father of modern art", genius painter Vincent van Gogh, only sold one painting while he was alive. His source of income came entirely from the funding of friends and family. This placed an enormous mental burden on him, which eventually led to the genius's death at a young age. We want to change this sort of situation, and change how an artist "must" live in poverty. The majority of artists live in poverty throughout their lives, and their pieces only increase in value after their death.

Jingchuan Yu is an artist our website has signed [11]. He is a professional astronomical artist, member of the International Association of Astronomical Artists, and the first Chinese painter to hold an individual exhibition on astronomical art and science fiction art. After using the Artval platform, he said, "Artval helps artists create a personal gallery in space, and can help artists establish and sell their work. I sincerely hope Artval succeeds!"

The Artval platform will also help ordinary consumers who love art and enjoy collecting, but who don't have enough appraisal experience. On this decentralized price setting platform, ordinary consumers can pay a certain price to take part in price setting activities, which will increase their ability to appraise a piece of art. After their appraisal ability improves sufficiently, they will be rewarded by the platform for setting prices that have a referential value. At the same time, ordinary consumers can directly purchase pieces of art whose prices have been set by the collective group for their personal collection or for resale on the platform.

5. Application Scenario

Artval's main application scenario is: first, the relevant information and appraisal details of the piece of art are registered on the blockchain; second, a price is set for the piece of art. Since the evaluation and price setting of art has been a long-standing problem in the industry, Artval uses the wisdom of the public to collectively set a price, then uses rewards to increase activity from participants, so control of the price returns to the hands of the majority; third, Artval uses smart contract technology to automatically allocate the piece of art's original and copyright benefits. As the piece of art circulates, the original artist will continue to receive added value of the piece, so that they are even better protected.



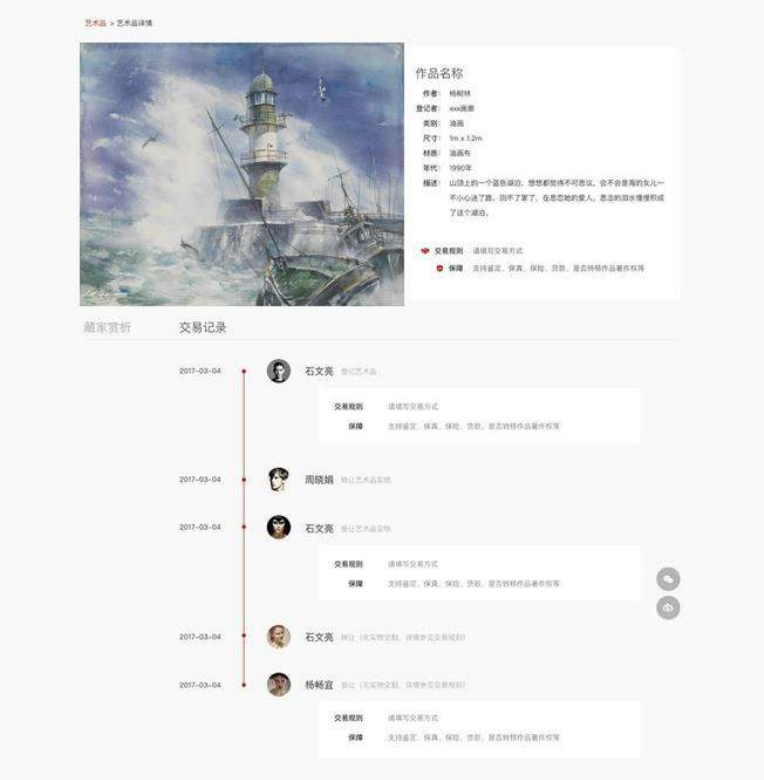
5.1 Digital Authentication

Art digital team of the authentication institution will serve for the artists and will create an art digital ID for each piece of art, and then gradually establish and improve a complete digital ID-based art digital ecosystem, creating a data tree with the creation, copyright exchange and transfer information.

Digital ID may be used as a basis for anti-counterfeiting authentication. When a collector desires to confirm the authenticity of a painting, he may compare the painting from the aspects of the whole painting, particular part and textures by virtue of authentication institution’s digital comparison technology and finally obtain a result about the authenticity probability which was achieved by technology. Starting from the original source of pieces of art, the artists authenticate the original pieces of art by themselves, and we conduct physical inspection, filing and authentication of the pieces of art. Through which we may create unique and authoritative "ID" information for each piece of art.

5.2 Circulation Confirmation

The trade and circulation information of a piece of art will be recorded on the blockchain, and will be available for everyone to read, with detailed records of the time, price, and identities involved for the sale of a piece of art. This record of a piece of art's circulation will help us appraise the authenticity of a piece of art to a certain degree. In the end, people might believe that only art with a blockchain record is real and authentic, and will only be willing to purchase pieces of art with blockchain records.



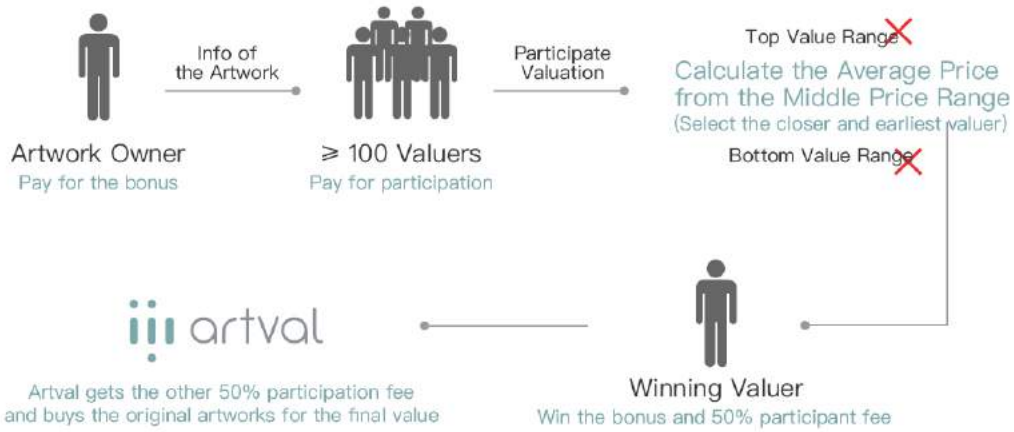
5.3 Open Access

The only digital ID of pieces of art will be registered at the blockchain through Artval platform, which will build a global-shared art digital asset database. Each piece of art may be searched and verified in such untamable blockchain database. And thus it builds an open and transparent art digital asset database that any institution and individual may access to.

5.4 Collective Pricing

Traditional pricing rights of pieces of art are possessed in the hands of a few people. The value of a piece of art is difficult to be recognized by the market. Such value may be affected by the author, history, transfer, quality, owner and other factors of the pieces of art, each of which may cause a fundamental difference in their valuation. However, the value of an piece of art shall be publicly recognized by the whole society. We conduct decentralized art valuation and pricing by drawing on the consensus of the whole society and use Artval Coin as the measure of price to reflect the whole society's recognition with respect to the value of each piece of art. We return the pricing right to the owners and make the pieces of art having more audiences. Our goal is that each piece of art is valued under a fair value judging system, free from the kidnapping of a small number of people and capital, and we

really return the freedom and value to art.



5.5 Continued Earnings

Let's take a look at the legal definition of continued earnings.

"*Droit de suite* (also known as resale royalties) is a part of the artist's property rights, or property rights of the copyright owner, with basic connotations that say: copyright owners of pieces of art, especially fine art, have the right to deduct a certain percentage from the added value assets of each sale of their piece of art. In other words, after an original piece of art to which someone possesses the copyright is sold, if the transferee sells it to another person for an amount that was higher than they originally paid for it, the original creator has the right to deduct a certain percentage from the added value. No matter how often the piece of art is sold and who it is sold to, the original creator has the right to a portion of the sale if it is sold for more than it was purchased for. [12]"

"Currently, over ten countries have specific regulations regarding protection of an original owner's *droit de suite.* France was the earliest country to establish this law, in its copyright article 42, which said, 'After the creator of printed works and formative arts transfers a piece, they still have an unalienable right to share in profits from any public auction or sale by a dealer of their work.' At the same time, France ruled that the term of protection would be 50 years, with a share of 3%, but if the sale was not at least 10,000 francs, the creator could not enact *droit de suite*. Italy's copyright law protects the *droit de suite* of drafts of paintings, statues, and other works of art for a term of 50 years, with shares of 10% or 5%. Germany's copyright law is fairly representative, as article 26 of its copyright law states, 'when an original piece of art is

sold or re-sold, if an art dealer, auction house, or any other agent is the buyer or seller of the art, the seller should pay to the creator of the art 5% of the re-sale price, unless the sale price is less than 100 marks.' [12]"

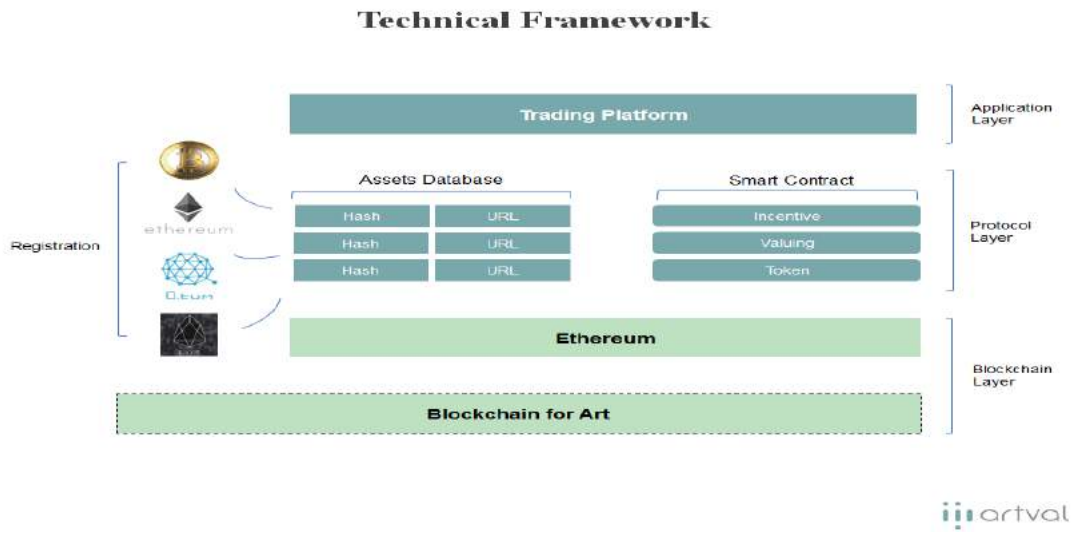
Artval uses smart contract technology to automatically distribute original content and copyright benefits of the art piece, so in further circulation of the piece, the artist will continue to receive added value. This solves the real issue of the law being difficult to enforce, so that the original creators of art can truly benefit from the law.

5.6 Copyright Application

In traditional market, the value of pieces of art determines the value of copyright. However the value of copyright is difficult to connect with the application of copyright. Artval guarantees that each copyright of art application is clear, and that the copyright can be traded and revaluated as a stand-alone product just like a piece of art. The increase of copyright value and the expansion of copyright application channel reflect the value of the original pieces of art itself. We gradually achieve the change from traditional one-way value to two-way value and build a channel in which copyright is an independent commodity and art IP can be monetarized.

6. Technical Framework

The system technical framework is divided into three layers, which from the bottom layer to upper layer are blockchain layer, protocol layer and application layer. The details are shown in the following technical framework diagram.



6.1 Blockchain Layer

Our plan for blockchain layer is to develop a public chain that will specially serve for the art industry. Please see Chapter 8 for details of the implementation thereof. At the beginning, we will still use the world's best development platform at present - Ethereum as the bottom blockchain platform of the system.

Ethereum platform is congested in a particular period. For example, both the concentrated issue of ICO projects in summer of 2017 and the CryptoKitties Project at the early of December 2017[13] caused the transactions in Ethereum platform cannot be identified in several days. Such congestion cannot be improved in a short term, which is the inherent problem of the existing blockchain technologies in terms of the extensibility and likely to be resolved in the coming years as the development of technology.

However, exchange in art industry is not frequent, which falls into the medium-low-frequency transaction. People can tolerate the settlement time of art transactions, without having to be paid immediately, like shopping at the supermarket. This is the basis that we can apply art applications to the blockchain platform. Initially, we will work on Ethereum platform. We will first well-establish our exchange processes, scenarios and other functional requirements. When user volume gradually increases and the frequency of exchange becomes high, we will transfer transactions to a public chain which is specifically developed for the art industry, so as to meet the functional (TPS) requirements of transactions.

6.2 Protocol Layer

The core of protocol layer consists of two parts: asset database and smart contract.

6.2.1 Asset Database

We expect to build a blockchain-based digital asset database for global art. At the early of 2017, we developed this Product on the Bitcoin Blockchain [14], which enables the registration or transfer of art digital assets on the blockchain by virtue of Bitcoin’s Nulldata transaction [15]. At that time, the price of Bitcoin is approximately US$1,000/BTC, which means that the charges of transactions are relatively cheaper. As a result of which, it is acceptable as the cost of registration and transfer of a piece of art is lower. However, as the price of Bitcoin have soared, charges have become

higher and higher and the registration or transfer of a piece of art may cost about US$50.

Therefore, with respect to the design of Artval project, we plan to implement registration and transfer process on multiple blockchains. In addition to the original Bitcoin chain which has been completed, we plan to support Ethereum, Quantum and EOS etc. [16-17]. In addition to cost considerations, we also find that art digital assets cannot have only one blockchain solution; we must be able to accept art digital assets from other sources. What we desire to achieve is that we will build a digital asset database for global art on the Artval blockchain (At present, Ethereum is the bottom blockchain and in future, we will build our own art blockchain), gathering all other sources of art digital assets. With respect of which, we adopt a decentralized method, using Artval as a decentralized predictor (Oracle) to decide whether to access art digital assets from other blockchains.

Pieces of art is the physical asset in the real world. Art digital assets are generally recorded by way of taking photos and videos and other methods. We package meta-information, photos, anti-counterfeit HD pictures, certified video and other digital information into a piece of art authentication document package. By virtue of the contents of such authentication document package, we may uniquely confirm the authenticity of pieces of art by adopting particular authentication comparison technology. As the limited storage space on the blockchain, we will only record the Hash of such authentication document package and the URL where such document package is located in the asset database, while the authentication document package itself is scattered in the traditional centralized storage directed by the URL or the computer of the artists. This storage draws on the decentralized storage method achieved by the Blockstack[18].

6.2.2 Smart Contract

We build a decentralized art exchange market with smart contracts. In this unprecedented art exchange market, tokens are used for the buying and selling of pieces of art, the pricing of pieces of art, the receiving of copyright benefits by artists, and paying of charges for transactional activities.

- **Token Contract**

  Achieve standard Ethereum ERC 20 contract interface or follow-up upgrade [19-20], issue Artval Token at Ethereum. Artval Token at Ethereum will circulate at Artval platform until we have developed the blockchain specially serving for the pieces of art. Thereafter, we will exchange Artval Token circulated at

Ethereum for tokens of art blockchain at a ratio of 1 to1 and gradually replace the tokens originally circulated at Ethereum.

- **Pricing Contract**

  Pricing contract is the core of Artval platform. With respect to the code implementation, it is not an Ethereum smart contract, but a portfolio of multiple interrelated smart contracts.

  The process of pricing is as follows:

  - The owners of pieces of art offer a certain amount of incentives, requesting measuring a price for their pieces of art.
  - Art enthusiasts sign up voluntarily, but need to pay a certain amount of participation fee, which will not be returned after payment. The more Art enthusiasts involved, the more they represent the market's fair price for the pieces of art.
  - With all estimates as input data, the final pricing of the pieces of art is calculated by virtue of a pricing algorithm
  - The appraiser who offers the closest value to the final price (more than one person, the ladder bonus will apply), will receive the bonus provided by the platform
  - The platform will transfer the tokens into the owner’s account in accordance with the final price

  The core of pricing contracts is the pricing algorithm which is not immutable. After the issue of pricing contract, pricing algorithm may be upgraded in accordance with the operation of platform. The upgrade program will be proposed by the core development team of Artval and the Community will decide whether to use such program by voting.

- **Incentive Contract**

  Incentive contracts will provide artists with a positive incentive mechanism which is based on the transfer of physical pieces of art and copyrights. During the transfer of physical a pieces of art and copyrights, the artists who are the source of a pieces of art’s value chain will benefit from the appreciation of pieces of art on a continuous basis. This is the greatest benefit that blockchain can bring to artists, because the blockchain can record the complete process of pieces of art transfer and through smart contracts can automatically allocate value-added return in the process of transfer by way of token.

6.2.3 Price Setting and Reward Algorithms

- **Final Price Confirmation**

a) Appraisers' prices in Array Q are ordered from low to high:

$$\vec{Q} = Sort(V_1, V_2, V_3, \dots, V_n)$$

$\vec{Q}$ is the array after being ordered. $V_{x,x\in\{1,2,3,\dots n\}}$ is the prices submitted by the appraisers.

b) From $\vec{Q}$ select:

max value $MAX(\vec{Q})$

min value $MIN(\vec{Q})$

c) Calculate the difference between the max and min values, and divide into seven groups:

difference max value (rounded up): Max $= \lceil MAX(\vec{Q}) - MAX(\vec{Q}) mod 10 \rceil$

difference min value (rounded down): $Min = \lfloor MIN(\vec{Q}) - MIN(\vec{Q}) mod 10 \rfloor$

interval between groups (rounded down): $S = \lfloor (Max - Min) \div 7 \rfloor$

group interval: $R_i = (Min + S \times (i-1) + 1, (Min + S \times i)],\ i \in \{1,2,3,4,5,6,7\}$

d) Remove the values of R_1 and R_7 in price array Q to get the final effective price array Q;

e) Calculate the average of Q' prices:

$$\overline{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$

where n is the number of values in Q′, and X_i is the ith value of Q';

f) Take $\overline{X}$ as the final price.

- **Reward Distribution Algorithm**

a) The number of reward recipients account for a certain proportion (in other words, confirm with number of reward recipients):

$$P = N * 15\%$$

where P is the number of reward recipients, N is the number of appraisers, and 15% is the proportion of the reward;

b) After successful appraisal, calculate the weight of the price of each appraiser:

$$W_i = \left(1 - \frac{|X_i - \overline{X}|}{\overline{X}}\right) \times 100$$

where $W_i$is the weighting of the ith appraiser's price, and X_i is the ith appraiser's actual price;

c) Arrange the appraisers' prices and selected value $\overline{X}$ from lowest to highest, then note the weighting of each price below;

$X_1,\ X_2,\ X_3,\ X_4,\ \ldots,\ \overline{X},\ \ldots, X_{n-3}, X_{n-2}, X_{n-1}, X_n$

$W_1, W_2, W_3, W_4, \ldots,\ 100,\ \ldots, W_{n-3}, W_{n-2}, W_{n-1}, W_n,$

(the weight of 100 is the value calculated as $\overline{X}$)

(1) Traverse from $\overline{X}$ (the median) towards both extremes, and select an appraiser with a weighting close to 100, until reaching P number of people; Once amount P of people are selected, continue traversing towards each extreme and check if there is anyone with equal weighting. People with equal weighting will continue to be selected into a candidate list;

(2) Order people with equal weighting on the candidate list based on the timestamp of their vote. Those with the earliest timestamp are added to the reward recipient list;

d) Finally, distribute rewards based on the proportion of weighting in the recipient list:

$$M_i = \frac{W_i}{\sum_{i=1}^{n} W_i} \times B$$

where B is the total number of rewards, and M_i is the total reward received by the ith person.

6.2.4 Contracts and Algorithm Upgrades

Artval's smart contracts and price setting and reward algorithms are the core of the platform's distribution of benefits. They will be initially designed and deployed by Artval's core development team, with follow-up upgrades developed by the team based on community opinion, which will be decided by using DPOS methods to vote [21].

6.3 Application Layer

Application layer generally refers to various platforms for art transactions. The core team of Artval will build an art online shopping mall which will adopt token as the settlement method. All other existing art e-commerce websites, art auction houses, art museums, galleries and other organizations may access to such shopping mall using Artval tokens to settle fees. Such shopping mall platform may provide the whole industry with a unified settlement method, just like WeChat and Alipay in China.

With respect to the software implementation, application layer consists of website, APP and API interface. Practitioner in art industry may build brand new art transaction platform based on Artval. The existing organizations in art industry may integrate API interface of Artval and use the innovative transaction method of Artval. Even more, after launching the art blockchain developed by us, organizations in art industry may issue their-own tokens like Ethereum platform. By this time, we have accumulated enough art registration and transfer information on our art blockchain. Based on which, organizations may create their-own industry applications and the market is well prepared.

In addition, we also need some assistant software, such as image recognition and

alignment software that may help identify the authenticity of pieces of art; 2D or 3D scanning technology that facilitates the digitization of pieces of art; RFID or other label technology that may trace the direction of physical pieces of art etc. Such system requirements will be embedded into the whole implementation of Artval system and a lot of innovation ideas that may change the art industry will appear in our community.

Storage and exhibition areas are also required during the transfer of physical pieces of art. During the business process of Artval, the platform will tentatively store the pieces of art in its own or cooperator's storage or exhibition areas, and then sell the same online or offline. We have completed the field trips in New York, Tokyo, Australia and plan to establish partnerships with local agencies.

7. Token

Artval platform is expected to issue tokens at Ethereum Blockchain with the code of ATL. The issue will follow Ethereum 20 agreement and the total amount will be 1 billion. There's no additional issue. The distribution plan shall be as follows:

Percentage		**Purpose**
30%	10%	Angel Investors
	10%	Private Investors
	5%	Public Early Bird
	5%	Public Offering
20%		Distributed to Team
30%		Allocated to pricing contracts for market-based subsidies and incentives on a phased basis.
20%		Reserved for subsequent investments

8. Roadmap

- January, 2017 – September, 2017

Having completed the development of a Bitcoin blockchain-based art registration and traceability platform, which has been launched and in operation [6]. Bitcoin

blockchain was selected as the bottom blockchain as it is the most stable and safe blockchain and is ideally suited to the perpetual succession of pieces of art.

- November, 2017 – June, 2018

Developing Ethereum smart contracts and asset database at protocol layer; extending authentication registration source into the blockchains other than Bitcoin blockchain; developing art online shopping mall at the application layer and preliminarily establishing storage and exhibition areas. After the completion of such stage, Artval platform can run all process and starts to online operation.

- July, 2018 – December, 2018

Based on the previous stage and according to the operational data and user's feedback, we will implement continuous iteration upgrades, improving the completeness of Artval platform's process and users' experience; optimizing protocol layer algorithms, integrating or developing other application layer programs according to the opinions of communities; absorbing more industry institutions to join in; and providing access to API interface to enlarge the circulation scope of tokens.

- January, 2019 – December, 2019

Through the construction completed in previous stages, we have verified our exchange patterns and user scenarios, built up user-friendly and completed upper-layer applications; in particular, tokens have gained supports in the art industry. At this stage, we will develop a proprietary art blockchain to support high-frequency transactions, provide safer guarantee for transaction, and offer smarter exchange algorithm and more complete exchange data storage plan.

9. Team

Core Team

Team Member	Introduction
Bin Sun Co-Founder	Graduated from the Department of Photography, Nanjing Arts Institute, Bin was a founder of Nanjing Yuanxiang Vision Studio and Nanjing Focused Culture Media Co., Ltd. and worked in Beijing Zhongke Yunrui Technology Co., Ltd. Bin is now an art blockchain early explorer, a serial entrepreneur and an artist broker. Bin is in charge of the operation and implementation of the

	project.
Bo Su Co-Founder	Graduated from the Department of Computer Science, Zhejiang University and obtained his MBA degree from Tsinghua University, Bo worked in CA China Technology Center, Websense China R&D Center, and NQ Mobile Security Cloud. Bo is proficient in security encryption and blockchain technology, and specialized in the design of bottom level system and server-side architecture. Bo is in charge of the technology and architecture of the project.
Wenjun Yuan Co-Founder	Graduated from the Department of Electrical Engineering, Zhejiang University and obtained his master degree from Beijing Institute of Technology and EMBA degree from Tsinghua University. Having 20 years' experience in both communication and internet industry, Wenjun worked for Nokia for many years, and was the founder of Easydong and Taoren Network, and a partner of a virtual equity exchange platform based on blockchain. Wenjun is in charge of the cooperation and marketing of the project.
Haishan Liang Blockchain Architect	Graduated from the Department of Computer, Huazhong University of Science and Technology. Haishan has 20 years of experience in technical development and focuses on low level system technology. Haishan is a full stack developer who worked at CA China Technology Center, Ku6 Network, and NQ Mobile Security Cloud.
Xingsheng Jiang Blockchain Architect	Graduated from Tsinghua University, Xingsheng worked in CA China Technology Center, Websense China R&D Center, Good Technology, and JD. He specializes in distribution system and network security.
Suxuan He	Graduated from Zhengzhou University, Suxuan worked in Alibaba ICBU before. He has 5 years of experience in network development, and is proficient in various

System Architect	development languages such as JAVA and PAP. Suxuan has rich experience in website configuration, payment system, and e-commerce industry.
Taizi Liu Product Director	Graduated from Sheffield University, UK and obtained his Master Degree. Taizi worked in many design and development companies and was in charge of numbers of independent development projects. He specializes in product and user experience design.
Davide Liu Algorithm Engineer	Studying at computer department of Universit à di Padova, majoring in AI and blockchain, and specializes in neural network, blockchain algorithm analysis and design.

Expert Advisory Group

Team Member	Introduction
Weidu Ma	Collector, antique connoisseur and presenter of "Lecture Room" of CCTV and serial programs named "Weidu Ma Says Collections". He is a member of China Democratic National Construction Association and a founder and current curator of Guan Fu Museum. Weidu Ma is also a columnist and expert of "China.org.cn" and an author of Super-bestseller.
Danqing Chen	Famous artist, writer and literary critic. He graduated from the Central Academy of Fine Arts. In 1980, his "Tibetan Group Painting" caused a sensation in art circles, and it was recognized as a classic masterpiece with epoch-making significance. Apart from painting, he published more than ten books of literature.
Fuxing Zhang	An executive director of the Chinese Painting Society of the Ministry of Culture, the vice-president of the Chinese Landscape Creation Institute of Sino-foreign Culture Exchange Center subordinated to the Ministry of Culture, and a researcher of Painting and Calligraphy Institute of Central Research Institute of Culture and History, a painter of the China Painting Academy for Friendly Contact. His works have traveled in space by Shenzhou

	VI and Shenzhou VII.
Chui Hu	Served in the Palace Museum since 1978, and worked as a director of the Information Center of the Palace Museum from July, 2004 to June, 2010. He is the secretary general of the Chinese Academy of Cultural Photography, the associate researcher of the Palace Museum and a member of the Academic Committee of the Palace Museum.
Qiang Ning	Archaeologist, art historian, art valuation expert, famous painter and Art PhD of Harvard University. He is one of "Changjiang Scholars" appointed by Ministry of Education of the PRC, professor of both Art Institute and History College of Capital Normal University and one of the special experts for Beijing "Haiju project". He was a teacher of Yale University, University of California, San Diego, University of Michigan and Connaught College. After returning to China, he was hired as the dean of School of Art of Lanzhou University, a professor and a doctoral tutor of Dunhuang Research Academy.
Jiang Li	Jiang is the CTO of Microsoft China, former president of the Innovation Research Institute of 21Vianet, and the Secretary General of Zhongguancun Blockchain Industry Alliance. He has 31 years' management experience in IT and finance industry.
Feng Han	A tutor in i-Center of Tsinghua University, a PhD of quantum physics in Tsinghua University. He is the chief editor of series of books "Wanxiang Blockchain Labs", and the Secretary General of DACA Blockchain Association. He is the chief editor of Blockchain New Economic Blueprint and Introduction and coauthored "Blockchain: From Digital Currency to Credit Society". He teaches blockchain courses with respect to the Internet Finance courses in Tsinghua University.
Liren Wang	An expert in Blockchain industry. He was the vice-president of Factom company. He is now a researcher of Beihang Digital Society and Blockchain Laboratory, co-founder of China Energy Blockchain Laboratory, senior researcher of China Blockchain Research Alliance, Deputy Secretary-General of Zhongguancun Block Chain Industry Alliance.

Shan Qingfeng	Qingfeng is the founder of Asch Chain. He is one of the expert members in the think-tank of China Guiyang Blockchain Innovation Institute. He is the founder and preacher of cross-chain technology in China as he has long been committed to bottom layer cross-chain technology and he has a profound understanding and unique insights to this technology.
Yann（French）	Yann has 18 years' experience in telecommunications and IT industry. He owns a patent for mobile phone security in the US. He had established and operated his own company and sold it successfully. Now he is the CTO of the world's largest intelligent hardware company for air pollution prevention.

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