Research on the Design of Public Rental Street Vendor Cart Service System Based on Blockchain Technology

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ABSTRACT

Objective: The aim of this study is to address the issues of urban management in the context of street vendor economy. Methods: First, the author analyzes the unsuitability of traditional street vendors in the current urban environment, proposes a design concept for shared street vendors, and then studies blockchain technology. Then, combined with its application scenarios in the field of smart management services, the author proposes the idea of applying blockchain technology to shared street vendor rental management. Finally, through design practice, the author specifically constructs the product model and service system of the street vendor cart. Result: A service system model can be obtained for public rental street vendor carts. Conclusion: This design scheme provides new product and service scenarios for the application of blockchain technology in smart city management.

Keywords: *Blockchain technology, Public rental, Street vendor carts, Service system design.*

1. INTRODUCTION

After the end of the COVID-19 in 2022, more and more cities have joined the ranks of "street vendor economy" to restore and boost residents' consumption. Many cities have successively issued local regulations to unify the planning of business models such as "roadside markets" and "outdoor stalls", and implement classified management to promote the healthy and orderly development of this economic form.[1] In early 2024, CCTV Finance released the first "China Night Economy Vitality Index Report", which pointed out that the size of China's night tourism market will reach 1.57 trillion yuan in 2023. The light asset sleepless city composed of food, night markets, and performances has become an important carrier of the night economy and is increasingly being praised by the market. Accelerating the layout of urban nighttime ecology will stimulate new consumption growth points in the local area.[2] With the hot topic fermentation of street vendor economy and night economy, it has also attracted the attention of a large number of scholars in China. Research mainly focuses on the normalization management of "street vendor economy" and the development strategies of "night economy" from the perspectives of management and economics. In the construction process of smart cities, how to effectively unify and reasonably layout the behavior of arbitrarily setting up stalls in the city has become the biggest challenge currently faced.

On October 24, 2019, during the 18th collective study of the Political Bureau of the Central Committee of the CPC, General Secretary Xi Jinping has emphasized the need to promote the combination of blockchain's underlying technical services and the construction of new smart cities, to explore the promotion and application of the blockchain in the fields of information infrastructure, intelligent transportation, energy and electricity, and to enhance the level of intelligence and precision in urban management [3]. The speech of General Secretary Xi Jinping has guided the direction for the application of blockchain technology to the intelligent management of cities.

2. THE PROBLEMS OF TRADITIONAL STREET VENDOR CARTS AND THE ADVANTAGES OF SHARING STREET VENDOR CARTS

2.1 The Unsuitability Problem of Traditional Street Vendor Carts in the Current Urban Environment

A street vendor cart is a mobile device used for street vendor business activities, providing convenience and support for street vendor operators. At present, in cities, the products of street vendor carts are mostly purchased or modified by stall owners according to their own needs. They are often placed in crowded places such as pedestrian streets, commercial districts, school surroundings, and large community surroundings, lacking unified standards and norms. The disorderly stall behavior has also brought many problems and challenges to the city, mainly reflected in the following aspects: Firstly, due to the lack of unified management and planning, vendors often randomly place their carts on both sides of the street, which not only affects the appearance of the city, but also occupies public spaces such as sidewalks and non-motorized cart lanes, leading to urban traffic congestion and seriously disrupting the normal travel of citizens. Secondly, due to the fact that street vendors are mostly mobile businesses and lack fixed sanitation facilities, they often litter indiscriminately, resulting in piles of garbage on both sides of the street, posing a major challenge to urban environmental sanitation management. Thirdly, there are certain safety hazards in the operation of street vendor carts. Some food and beverage vendors use equipment such as gas cylinders and wires, which poses certain safety hazards. In addition, many small vendors do not have hygiene business licenses, and it is difficult to trace the source of their cooked food products, which can easily lead to food safety issues.[4] Therefore, in response to these significant issues, it is urgently necessary to address these problems by developing and designing new types of street vendor cart products and service forms that better meet the needs of modern urban development, in order to achieve scientific management and regulation of urban stall behavior, and ensure the sustainable and healthy development of the hustle and bustle cities.

2.2 The Advantages of Sharing Street Vendor Carts

In recent years, shared products and service models in cities have been highly favored by citizens for their convenience and maximization of resource utilization [5], such as shared charging stations, shared power banks, shared cars, shared bicycles and other transportation tools, which have provided us with successful business cases and good user experiences. The public rental street vendor cart proposed in the article is a type of cart provided by the government or relevant commercial institutions for street vendor operation that can be rented. This type of carts provides convenient movable stalls for street vendors, allowing them to easily conduct business activities in different locations. At present, it is not common for cities to provide public rental service of street vendor carts. However, with the rise of the street vendor economy and adjustments in urban management policies, some cities have begun to try and promote this service. For example, Guangzhou Sanfeng Car Rental Company provides car rental services for mobile vendors, providing convenience and support for street vendor operators.

The advantages of public rental street vendor carts lie in their convenience and standardization. Street vendors do not need to purchase their own stall carts, and can obtain a legal and standardized stall through leasing, reducing the cost of initial investment. In addition, public rental street vendors can also be customized according to the needs of the operators to meet different business requirements. For cities with the goal of building smart cities, incorporating the needs of ordinary citizens into the overall planning not only reflects the attention to people's needs, but also starts from top-level design to effectively solve the problems of excessive investment and difficult management in the early stage of setting up stalls in the city, and improve the urban environment, having certain value.

3. BLOCKCHAIN TECHNOLOGY

Blockchain is a term in the field of information technology. It is a decentralized distributed database based on P2P network technology and encryption technology, characterized by openness, transparency, tamper resistance, traceability, security and trustworthiness, and privacy protection [6]. Blockchain technology, with its unique characteristics of digitization and decentralization,

demonstrates enormous potential for integration with technologies such as the Internet of Things and big data. Scholars Sun Biao et al. (2021) [7] utilized the trust system built by blockchain technology, digital workflow, and the advantages of combining with other technologies, combined with the opportunities of new shared car service scenarios, to study new service design strategies for the shared car service ecosystem. Based on the current research status of smart communities, community public services, and precision supply, Ji Hong (2022) proposed the necessity of using new infrastructure, especially blockchain technology, to enhance supply capacity in response to the challenges faced by community public service supply in the post pandemic era. Through theoretical support, current situation comparison, field research, and trend analysis, this paper explores the suitability and future implementation path of blockchain driven precision supply of community public services. Zhang Guoqiang et al. (2023) [9] conducted research on the use of blockchain technology to construct a trustworthy traceability solution architecture for military food supply chains, achieving security assurance and full process traceability of traceability information, supplemented by supporting measures, effectively improving the trustworthy traceability level of military food supply chains. These documents show that blockchain has gradually evolved from encrypted digital currency to a platform that provides trusted blockchain and services, providing practical value for the landing of blockchain technology in the sharing field and bringing specific feasibility to the intelligent management of cities.

4. DESIGN STRATEGIES FOR PUBLIC RENTAL STREET VENDOR CART SERVICES BASED ON BLOCKCHAIN TECHNOLOGY

4.1 Prototype Design of Public Rental Street Vendor Carts

The article proposes the concept of "vendor cart rental". Based on the user-centered design principle, the design takes the needs and pain points of the majority of stall owners as the starting point, designs products and services that meet user expectations and satisfaction. In order to meet the needs of more consumers, the design adopts modular design, integrating multiple functional service modules. Users can choose their own needs on the system according to the type of products they sell, and provide personalized customized services.[10] The cart is entirely composed of modular components, which can achieve integrated transportation, assembly, and disassembly, making it convenient for the public and beneficial for the management and maintenance of operators, as shown in “Figure 1”.

Figure 1 Prototype design of public rental street vendor carts.

4.2 *Design Scheme of Sharing Street Vendor Cart Service System Based on Blockchain Technology*

4.2.1 Business Process

In a public street vendor cart rental solution based on blockchain technology, the lessee uploads personal identity information and stall operation content on the service platform, generates a unique digital identity, and stores it on the shared institution blockchain platform as the lessee's unique identifier and voucher in the service system. The system determines the distribution of stalls based on the lessee's credit. After completing the stall task, the lessee needs to upload garbage classification and recycling information, store it in the garbage recycling block, and the system calculates and updates the lessee's credit score based on their behavior and performance in the service system, which serves as their credit record and evaluation in the service system. The rental agency forms a smart contract based on the lessee's digital identity and credit score, as well as their own set leasing conditions and rules, and deploys it on the blockchain platform as an agreement between the leasing parties. The urban regulatory department implements supervision based on the information traceability of each block. The platform design adopts an alliance chain approach, with multiple relevant interest organizations as alliance members, building multiple nodes connected by a network to jointly participate in the management and maintenance of the system, ensuring the traceability of multiple information. The lessee can provide rental services and related information for street vendors through the WeChat mini program. The specific business process is shown in “Figure 2”.

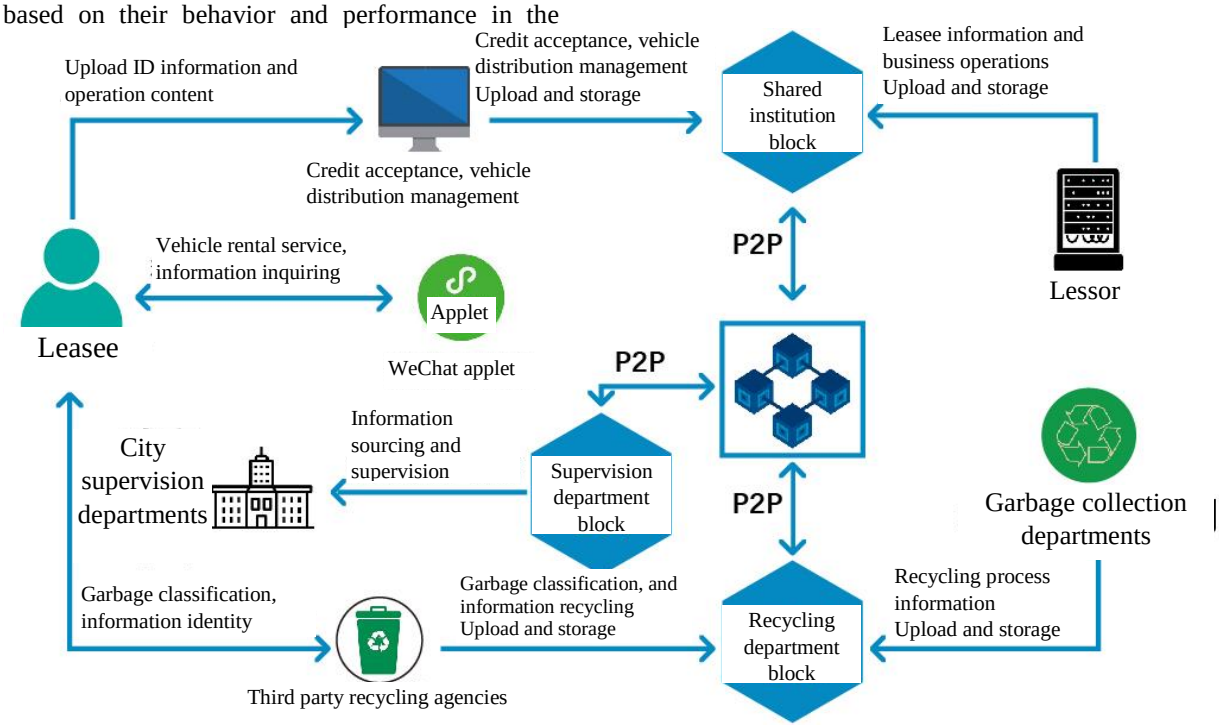

Figure 2 Business process of blockchain based shared bike sharing service platform.

4.2.2 Platform Framework Design

The overall architecture of the shared street vendor car rental service platform based on blockchain technology in this study mainly includes the application layer, consensus layer, incentive layer, and data layer, which cooperate with each other to achieve a decentralized credit mechanism. The technical framework is shown in “Figure 3”.

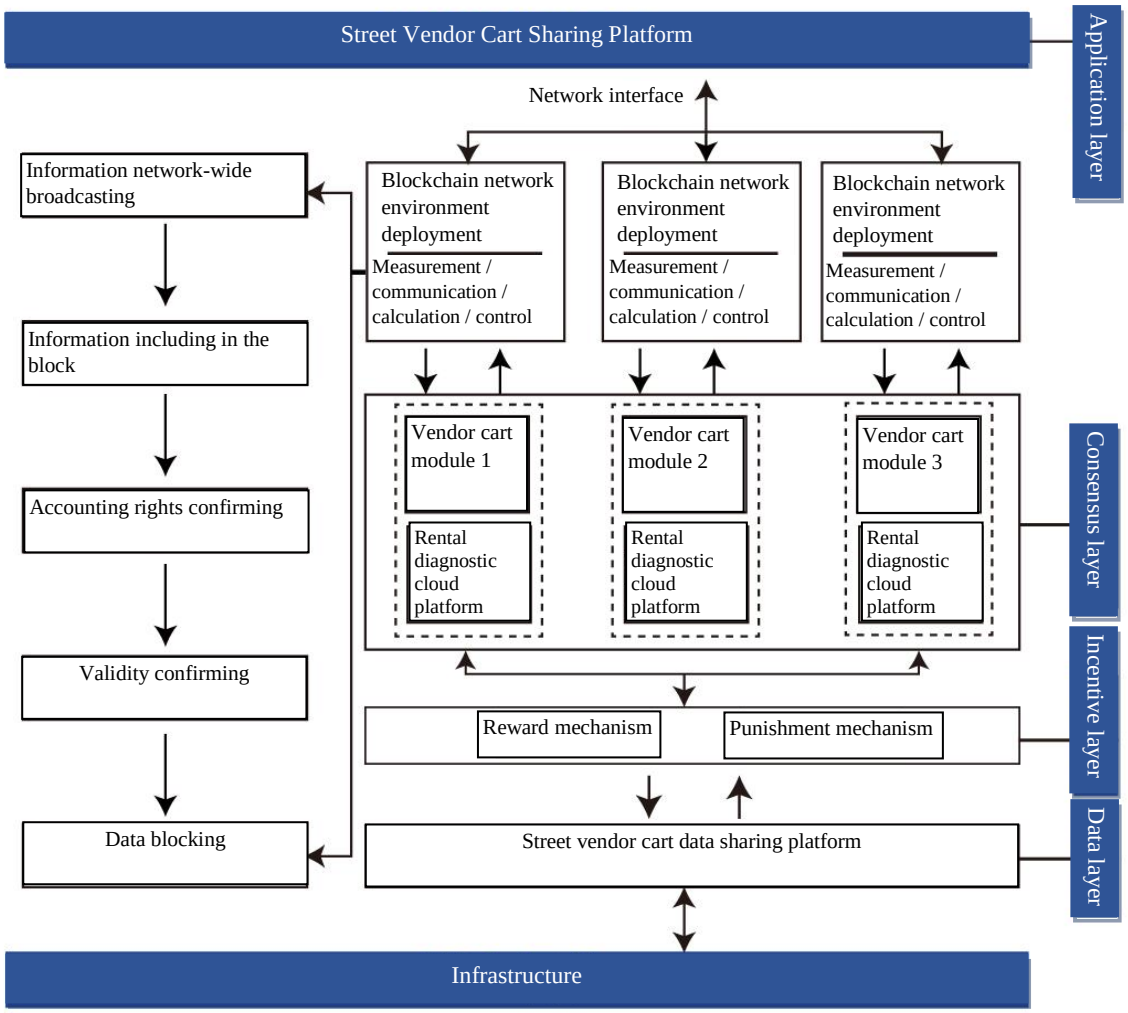

Figure 3 Technical framework diagram of a blockchain based shared street vendor cart rental service platform.

4.2.2.1 *Application Layer*

The application layer mainly targets two types of users: tenants and rental agencies, providing them with a web interaction interface between the client and server, as well as a mobile app, allowing users to conveniently operate and manage the system anytime, anywhere. The rental service process has been streamlined and optimized based on the main services provided by public rental street vendor carts, including the use of different types of street vendor carts, selection of rental packages, management and maintenance of street vendor carts, and delineation of the scope of street vendor stalls. This has resulted in the creation of the "Urban Public Rental Street Vendor Cart" app. This APP is a mini program that integrates online personalized booking and leasing, intelligent positioning, and recycling. Users who are interested in setting up stalls can search for the most suitable stall in the "Urban Public Rental Street Vendor Cart" APP to place an order. After successfully placing an order, they can then set up stalls according to the recommended area positioning in the APP.

4.2.2.2 *Consensus Layer*

The consensus layer is the core layer of the blockchain system, which supports the operation of the leasing diagnostic cloud platform. All transaction data on the leasing cloud platform is publicly transparent, and any stakeholder can view relevant information through the service platform. The lessee is responsible for entering information on the items sold, garbage collection and classification information, and cart safety and maintenance information while using the stall. The lessor is responsible for querying information through the traceability system and implementing

supervision and cart maintenance management. The blockchain based traceability system provides a new trust mechanism and solution for promoting shared bike sharing in cities.

- Traceability of the Content of Vendor Cart Operation

Regarding important issues such as food safety for mobile vendors selling food, vendor cart users have the responsibility and obligation to upload sales information on the service platform when using the stall, and are responsible for the authenticity and accuracy of the uploaded data. For tenants who do not enter information, credit points will be deducted, directly affecting the later rental and various services of the service platform. Consumers can search for product traceability information through websites and mobile apps. This constraint indirectly enhances the safety and hygiene awareness of vendors and solves food safety issues.

- Traceability of Garbage Classification

How to achieve the classification, recycling, and rapid disposal of garbage generated during the process of setting up stalls by tenants is an important issue facing urban management. As the direct responsible person for the generation of garbage, the vendor needs to bear the main responsibility for garbage classification, correctly classify and dispose of garbage, and guide consumers to classify garbage to avoid mixing and littering. And based on blockchain technology, there is a must to classify and trace the origin of garbage, track the generation, collection, transportation, and processing of garbage in real time, and achieve transparent supervision of the entire garbage classification process. On the blockchain platform, peer-to-peer transactions with the garbage recycling department can also be achieved, enabling seamless integration between emitters and recyclers. In addition, certain incentive policies can be accurately provided to emitters to encourage source garbage classification and recycling, and to strengthen source demand side management.

- Traceability of Responsibility for Damage to Vendor Carts

The division and traceability of responsibility are also important for the damage caused to street vendor carts during use. The blockchain sharing platform digitizes and encodes parts of easily damaged modules such as steering wheels, windshields, and lighting fixtures in the area, and records them in the blockchain. Every lessee who causes damage to their cart due to human caused collisions during the use of the stall can upload information through the service platform, can enter the damage situation of the cart module, and activate the corresponding module's smart contract in the background. They can apply for service provider intervention for repair online. The solution can not only save the operating costs of the service platform, but also quickly understand the situation of the stall. For tenants who do not report in a timely manner, it not only affects their continued use of the stall, but also affects their right to use it in various application scenarios in daily life.

4.2.2.3 Incentive Layer

By utilizing blockchain technology to achieve the traceability, trustworthiness, and incentivization of data, it is possible to establish and improve the leasing credit record and evaluation system of street vendors, and enhance the trust and cooperation level between leasing parties. On the shared street vendor cart service platform, users will have data traces on the rental of street vendor carts and the requisition and return of service resources. After completing the process of returning service resources, users can receive rewards such as mobile application deduction of rental fees, priority use, and red envelopes. In addition, during the external use process, users who actively comply with the contract, such as good garbage classification, high food hygiene and safety coefficient, and good bike maintenance, can be rewarded with token deduction of rental fees incentive mechanism. This can invisibly regulate the behavior of users in using service facilities, improve the environmental awareness and behavior level of stall operators, and form flexible management of bike sharing. In addition, at the end of use stage, tenants can earn reward points by writing reviews and sharing their platform usage experience. Renters continuously iterate and update based on the daily operational data and user feedback of street vendor carts, optimizing the user experience. Sustainable development of products and services can be achieved through a series of processes including user application, review, use, return, and evaluation.

4.2.2.4 Data Layer

The street vendor cart sharing platform obtains the signals of the street vendor carts and translates them to obtain the signals of the working hours and garbage classification of the street vendor carts.

Through scripts, the data is cleaned and calculated, and a data report is generated every interval. After the current data report is generated, the MD5 code of the report is generated by signing the script with the private key and written into the block. At the same time, the data collection is started for the next data report. The data sharing platform for street vendor carts adopts a distributed architecture based on consortium chains. Information such as the location, status, and transaction records of street vendor carts is deployed and shared through a blockchain environment. The data sharing platform for street vendor carts and the street vendor cart sharing platform share a blockchain network to achieve information broadcasting across the entire network.

4.3 Optimization of Shared Street Vendor Cart Service Experience Based on Blockchain Technology

In the process of optimizing the experience of public rental street vendor cart services, it is necessary to fully utilize the advantages of blockchain technology, such as data security and privacy protection mechanisms, to ensure that the lessee's experience is as close as possible to the comfort and convenience of their own cart, and to experience the unique advantages of the sharing model supported by technology.

4.3.1 Convenient Cart Rental Methods

It is crucial for tenants to use public street vendor carts as conveniently as operating their own street vendor carts. It determines the market prospects of this product and service model. To achieve this goal, the researchers are particularly focused on optimizing the convenience of cart rental. The researchers combine the decentralization and smart contract features of blockchain, as well as the image recognition and real-time query functions in 5G technology, to provide accurate navigation guidance for tenants from home to the rental site of street vendor carts, ensuring that users can quickly and accurately locate the desired cart. In addition, tenants can also make advance reservations for setting up stalls at their destination through the service platform, eliminating anxiety caused by insufficient stalls and saving tenants time in finding suitable stalls. By optimizing convenient cart rental methods, every renter can enjoy easy, efficient, and intelligent public rental services.

4.3.2 Personalized Service

To meet the diverse and personalized needs of users, the street vendor cart rental service platform provides flexible rental duration and a wide range of modular cart selection, allowing tenants to fully enjoy the convenience brought by the sharing mode. When the lessee chooses to share a stall, the platform will intelligently predict and recommend the most suitable stall module based on the sales content information input by the lessee, including the combination of functional modules, operation methods, and suggestions for stall blocks. This method not only screens out the optimal solution for the lessee in advance, but also greatly reduces the selection time. The lessee only needs to confirm the information of the street vendor cart and can directly rent it. This personalization and convenience will also positively motivate users to use shared street vendor carts. During the operation process, the lessee will also be evaluated based on the credit system, and according to the evaluation results, value-added services such as leasing preferential policies or exemption of leasing fees will be provided to eligible lessees.

4.3.3 Precise Planning and Management

In order to facilitate the more scientific and effective planning and management of stall areas by urban regulatory departments, the blockchain technology service platform can be relied upon to collect and analyze past stall operation data, urban health and transportation environment status. By analyzing these business and city data in detail, the researchers can more accurately grasp the operation and urban operation status of each street stall economy, including key information such as activity level, distribution of product types, consumer preferences, and urban health index in each region. Based on this data, more reasonable street vendor area planning can be developed to ensure the rational allocation and effective utilization of resources, and the healthy operation of the city. At the same time, these data can also provide strong support for urban regulatory departments, helping them better supervise market order, protect consumer rights, and promote the healthy and sustainable development of the street vendor economy. This optimization iteration measure not only helps to enhance the vitality of the street vendor economy, but also creates exemplary street vendor areas, adding unique charm to the city.

5. CONCLUSION

This article integrates blockchain technology with the needs of smart cities, and constructs a shared street vendor product and service system, achieving efficient urban management under a good credit system in the street vendor economy. By utilizing the consensus mechanism and encryption mechanism of blockchain, the entire process information of user rental cart business, including user registration, rental application, credit evaluation, payment settlement, and garbage collection, is stored and shared. This connects the information links of the lessee, rental institution, urban regulatory department, and garbage collection department, improves the transparency of the entire rental process, facilitates dynamic tracking and post traceability, not only promotes the improvement of safety issues such as food sales by mobile vendors, but also enhances the city's intelligent management capabilities, and further effectively improves the happiness index of urban residents. The innovative model of "software + hardware + service" system integration driven by this technology not only helps promote the development of street vendor economy, but also provides exploration and practice for the application of blockchain technology in the field of people's livelihood and urban intelligent management.

At present, there are no service cases of shared street vendor carts in China. It is hoped that the application model of "blockchain + shared street vendor carts" in this service system can provide new products and management ideas for the development of smart cities, and provide useful reference for the supervision of shared street vendors.

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