

A Digital Community Group Buying Platform Based on Blockchain, AI and IoT Technologies: Smart Village Revitalisation Scheme

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Abstract

With the in-depth development of digital transformation, the concept of smart villages has emerged, aiming to improve the quality of life and economic development of rural areas through technological means. This thesis delves into the application of blockchain, Artificial Intelligence (AI) and Internet of Things (IoT) technologies in building a digital community group-buying platform to achieve the goal of the Smart Village Revitalisation Plan. As an emerging business model, community group purchasing effectively reduces costs and improves efficiency through centralised procurement and distribution, bringing convenience to residents in rural areas

Keywords

Smart villages; Community group buying; Blockchain; artificial intelligence; Internet of things.

1. Introduction

1.1. Background to the study

With the development of the times, the competitive pressure of society has been intensified, people's daily life available time is limited, community group buying with its own convenience and pro-people based on the market, since the consolidation of the contemporary people have been active in the field of vision. As a new way of shopping, its role is not only reflected in the daily convenience, it also has a very important potential significance, for the revitalisation of the rural economy also plays a key role. The completion of the community group purchase for the sale of agricultural products to create a new business path, so that customers through the head of the indirect communication with farmers, so that agricultural products have a place to sell new, to help the development of the countryside, and provide new impetus for the revitalisation of the countryside. The way the products are directly exported from the origin also improves the freshness of the products.

1.2. Significance of the study

(1) Interdisciplinary integration. The research integrates and applies blockchain, artificial intelligence and IoT technologies to the rural community group purchasing platform, achieving interdisciplinary integration. This interdisciplinary research approach provides a new perspective for academia, promotes communication and cooperation between different fields, and promotes the application and innovation of technology in rural development.

(2) Addressing information asymmetry. The traditional rural supply and marketing model suffers from the problem of information asymmetry, which leads to dilemmas such as high fluctuations in the prices of agricultural products and unstable income for farmers. The digital community group purchasing platform ensures the transparency and non-tamperability of information through blockchain technology, and achieves the ability to accurately match

demand and resources through artificial intelligence technology, thus effectively solving the problem of information asymmetry and improving the efficiency and fairness of agricultural product transactions.

(3) Promoting rural economic development. The digital community group-buying platform provides a new economic growth point for the countryside. By directly linking producers and consumers of agricultural products, the platform can help farmers sell their agricultural products and raise their incomes.

(4) Promoting rural community building. Through the platform, residents can easily access high-quality agricultural products and also participate in the management and decision-making of community agriculture, which enhances their sense of belonging and participation and promotes the construction and development of rural communities.

1.3. Research methodology

(1) Building online platforms. Build a website and a convenient applet to attract community residents to use it, effectively connecting the community with the countryside. And record the usage.

(2) Data sharing and management. Data sharing and management can be achieved through blockchain technology, which can establish a decentralised data storage and management system and achieve secure data sharing and management. Meanwhile, through smart contracts and other technologies, automatic verification and auditing of data can be realised to improve the reliability and security of data. Through the continuous updating of data, real-time information is provided to urban and rural residents.

(3) Intelligent decision-making. Intelligent decision-making and management through artificial intelligence technology, using big data and machine learning and other technologies to respond quickly to orders and user needs.

2. Application of Blockchain Technology in Digital Community Group-Buying Platforms

2.1. Advantages of blockchain technology in digital community group buying platforms

Transparency of information. Transaction records can be viewed and verified by all participants, thus increasing the credibility of the transaction. Data Security. The use of distributed storage and encryption algorithms ensures data security and tamper resistance, effectively preventing the risk of data tampering or deletion. Decentralisation. Blockchain technology removes the need for traditional centralised institutions, allowing transactions to take place directly between participants, reducing transaction costs and risks. Smart Contracts. Blockchain technology supports smart contracts that automatically execute pre-coded contract conditions, thereby simplifying the transaction process and increasing its efficiency and reliability. Traceability and Tracking. Consumers can enquire about the production process and distribution trajectory of products through blockchain, which enhances the trust and traceability of products.

2.2. Challenges of blockchain technology in digital community group buying platforms

Performance and scalability: blockchain technology currently suffers from performance and scalability issues such as slow transaction processing speed and low throughput, which in a digital community group-buying platform may affect user experience and platform scalability. Privacy protection: the open and transparent nature of the technology may expose users' transaction information and private data, which makes it a challenge to protect users' privacy

while ensuring data security. Standardisation and legal regulation: The lack of unified standards and regulatory mechanisms may affect the development and application of digital community group-buying platforms. Cost and complexity: the application costs are high, including technology development, maintenance and operation costs, etc. Moreover, the complexity of blockchain technology may increase the difficulty of platform development and management.

3. Application of Artificial Intelligence Technology in Digital Community Group Buying Platforms

3.1. Advantages of Artificial Intelligence Technology in Digital Community Group Buying Platforms

- (1) Intelligent recommendation. Through the analysis of the user's purchase history, preferences and behavioural data, artificial intelligence can provide more accurate, more convenient, more personalized service, improve the user's satisfaction with the purchase and the matching degree of the goods to enhance the consumer's shopping experience consumers, the trust and loyalty to the community group purchasing group building.
- (2) Automated customer service. Artificial intelligence can use natural language processing technology to create intelligent customer robots for automated customer service that can provide more efficient customer service by quickly answering user questions and solving problems 24 hours a day.
- (3) Agricultural data analysis. Artificial intelligence can collect, record and visualise and analyse agricultural data, provide predictions and recommendations for agricultural production, and improve agricultural productivity and product quality.
- (4) Demand analysis and forecasting. By collecting and analysing big data such as consumers' purchase history, browsing behaviour, keyword searches, etc., AI can accurately predict the consumption demand of community residents, so as to carry out more effective merchandise procurement and inventory management.

3.2. Challenges of Artificial Intelligence Technology in Digital Community Group Buying Platforms

- (1) Data privacy leakage risk. Artificial intelligence has potential information security and privacy issues when collecting and analysing processed data, when using artificial intelligence technology, it is necessary to collect and analyse a large amount of user data, which may not only involve the privacy of the user, but also a large amount of agricultural data, including meteorological data, soil quality data, crop varieties and quantities, etc., and disclosure of this kind of data may lead to personal privacy and business secrets leakage and potential risks. Data, as an important asset in the smart era, will harm the interests of agricultural staff if they are acquired by hackers; if the data are used maliciously, such as being used for futures trading and identity impersonation, social stability will be affected.
- (2) Transparency and interpretability. Artificial intelligence technology in the decision-making process, there may be a black box problem, the user can not understand the reasons and process of its decision-making, the need to improve the transparency of the algorithm and interpretability, to increase the user's sense of trust.

4. Application of IoT Technology in Digital Community Group Purchasing Platforms

4.1. Advantages of IoT technology in digital community group buying platforms

(1) Optimising supply chain management. Through the Internet of Things equipment, real-time collection of agricultural products from production to warehouse storage to logistics management and then the final distribution of the whole process of information, to ensure the quality and freshness of agricultural products, the use of the collected platform sales data and inventory data information to help the platform to predict consumer demand, to facilitate the platform to replenish goods in a timely manner to solve the product pile up and the shortage of goods, to achieve real-time tracking of the logistics and distribution vehicles, to optimise the distribution route to improve logistics efficiency, can reduce the logistics delivery time and delivery costs. Optimise distribution routes to improve logistics efficiency, reduce logistics delivery time and delivery costs.

(2) Bringing better service experience to customers. Through the Internet of Things, big data and other technologies, the collection of user shopping information, understanding of the user's shopping habits and shopping preferences, recommending to customers the products that customers like, as well as legally collecting customer location information, recommending to customers the location of the nearest community service site, the customer can independently choose the online and offline purchasing methods, online purchasing methods combined with the Internet of Things payment system can provide customers with a more convenient payment experience, such as mobile payment, face payment and so on. The online purchase method combined with the payment system of the Internet of Things can provide customers with more convenient payment experience, such as mobile payment, face scanning payment, etc. In addition, the online purchase method intelligently selects the nearest selling point, so that the products can be delivered to the customers more quickly, and the community group purchasing mode can strengthen the connection between people and enhance the social attributes of all of us, for example, by soliciting the consent of customers to show the user's group purchasing information in the community display screen, and we can discuss the products at the same time, which increases the interaction and communication of the neighbourhood.

(3) Optimising product safety and quality management. Internet of things technology can be used to control and supervise the production of agricultural products, to ensure that the product safety can be trusted, once the quality of the product is found, it can be quickly located, and to take appropriate measures to solve the problem, and in the case of shoddy products are endless, through the Internet of things technology, it can be realised that the authenticity of the product can be verified as well as traced back to the source of the product, to increase the credibility of the customer, so as to attract more customers.

4.2. Challenges of IoT technology in digitalised community group buying platforms

4.2.1. Technical aspects

As there are many types of IoT devices and a stable network connection is required to run the devices, there may be compatibility problems with devices made by different manufacturers. Moreover, in some remote areas with unstable network coverage the devices cannot operate properly, which greatly limits the development space of the platform. If there is no standardised data format, the format of the data collected by different devices may also be different. The community group purchasing platform aims to combine the community and the countryside to promote rural revitalisation and sustainable development, and in some rural areas the platform may not be able to operate properly due to incomplete network coverage, and the Internet of

Things (IoT) technology is facing a considerable challenge in the implementation of digital community group purchasing.

4.2.2. Data security and privacy protection dimensions

IoT devices face threats such as leakage and malicious tampering when collecting user data and transmitting data. The digital community group-buying platform can't avoid collecting users' personal information, such as real-name information, telephone number, etc., when the information is leaked out, the consequences are very bad. When recommending products to customers, it will also collect customer preferences and customer purchase information, etc. If customer information is maliciously and illegally used, it will lead to a large loss of traffic.

4.2.3. Cost level

Deployment of IoT equipment requires a certain amount of upfront investment, digital community group-buying platform as a small group-buying platform for the community and rural economy, for a small platform, the initial investment is a considerable expense, the later maintenance and management of the equipment also requires a certain amount of investment, so the use of IoT technology in the application of the digital community, how to reduce the excessive cost is also a problem.

5. Design and Realisation of a Digital Community Group-Buying Platform

5.1. System architecture design

5.1.1. Technical layer

The use of blockchain technology can ensure that the records of transactions and information on supply chain management cannot be tampered with, automatically executing the community group purchasing contract to ensure the interests of buyers and sellers, and at the same time, using the decentralised characteristics of blockchain technology to ensure the authenticity of the user's identity, as well as the anonymity of the user's transaction information.⁰ . Through big data and artificial intelligence to predict the needs of users, based on the collected user preferences and historical purchase records to recommend appropriate products to the user, the establishment of artificial customer service, so that you can set up a quick response, to bring customers to provide better service and experience. It is also possible to use live broadcasting to monitor the production of agricultural products and transport logistics information in real time, through the automatic control of the Internet of Things and the collection of data can be automated inventory and inventory management, for example, for cold chain logistics, monitoring and collecting the temperature of the goods, to maintain the goods at the right temperature to ensure the freshness of the goods.

5.1.2. Application layer

Design a suitable operation interface, provide users with a friendly operation interface, allow third-party services, standardise the agreement, and clearly manage the process of group purchasing, the group purchasing of products is initiated by the head of the group, and then the user selects the desired agricultural products to join the group, the community starts to prepare the goods after the success of group purchasing, and then transported by the logistics to the user's destination, and the group purchasing is finished. The payment system adopts an integrated and secure online payment function.

5.1.3. Security and privacy protection layer:

Adopt data encryption system and real-time monitoring of system status and performance to protect data transmission and storage from leakage, use relevant technology to automatically back up important data to ensure that important data will not be lost, control access to

information to ensure that only authorised users are allowed to access sensitive data, and set up regular compliance checks to ensure that the platform follows relevant laws and regulations.

5.2. Data management and security design

5.2.1. Data management design

The data management level can make use of blockchain's distributed bookkeeping technology to ensure that all transaction records, once written, cannot be tampered with, increasing data transparency and traceability.⁰ The signing of smart contracts to automatically execute group-buying agreements, such as order processing, payment and refund steps, can reduce errors and delays caused by human reasons, and through the decentralised features of the blockchain, it can provide users with a more secure way of identity verification, protecting personal information from being abused and leaked out. By adopting artificial intelligence technology, historical data is analysed to predict customer group-buying demand, optimise inventory management and supply chain management, and based on users' purchasing history and preferences, appropriate group-buying products can be recommended, thereby increasing user satisfaction and purchase rates.

5.2.2. Security design

Use of data encryption systems. Encrypt the data to be stored and transmitted to prevent the data from being leaked out, as well as unauthorised access to some websites, strictly control permissions and access, authenticate visitor information from multiple aspects, and ensure that only authorised users can access some sensitive data on the platform. Regular network security verification and vulnerability scanning, timely identification and repair of security holes to protect data security, and the development of relevant agreements on the use of user privacy authorisation mechanism to protect user privacy and security.

5.2.3. Functional module design

The function of the platform is divided into three sections, one is personalised recommendation function, using artificial intelligence big data technology to recommend products that meet the needs and preferences of customers, the second is the function of real-time viewing of agricultural products processing, or picking process through the form of live broadcasting, and the third is the function of displaying the nearby location and real-time reporting of logistics distance and delivery time.

6. Implementation and Effectiveness Evaluation of the Smart Rural Revitalisation Programme

6.1. Objectives and Strategies of the Smart Village Revitalisation Programme

6.1.1. Target

The Smart Rural Revitalisation Programme aims to build a digital community group-buying platform through the use of blockchain, AI and IoT technologies to connect communities with villages, provide communities with high-quality agricultural products while helping rural areas to broaden their sales channels, achieve digital transformation and economic development, enhance the level of rural economic development, improve the quality of life of farmers, and promote rural revitalisation and sustainable development.

6.1.2. Strategies

Strategies for developing the Smart Rural Revitalisation Plan include building a digital community group-buying platform, integrating blockchain technology to ensure information transparency, product traceability and transaction security. It also uses artificial intelligence technology to achieve personalised recommendations and improve the efficiency of recommending and matching products, and uses IoT technology to achieve intelligent logistics

and distribution to connect villages with communities. Strengthen training for farmers and platform managers to improve their ability to apply digital technology. Increase farmers' and consumers' awareness of and participation in digital community group-buying platforms by publicising and promoting the Smart Rural Revitalisation Programme. Finally, establish a monitoring and evaluation mechanism to regularly assess and adjust the effectiveness of the programme's implementation.

6.2. Methods for assessing the effectiveness of the Wisdom Rural Revitalisation Programme

6.2.1. Transparency and security assessment of transactions

Ensure transaction transparency and security of the community group-buying platform through blockchain technology, which records all transaction information and guarantees that it cannot be tampered with, and assesses the transaction efficiency and security of the platform.

6.2.2. Real-time monitoring and feedback

The use of IoT technology to monitor real-time information on product inventory, logistics and transport conditions provides timely feedback and adjustment opportunities for community group-buying platforms to assess the operational efficiency and service quality of the platforms.

6.2.3. User experience assessment

By analysing user feedback and behavioural data through artificial intelligence technology, we assess users' experience and satisfaction with the community group-buying platform, identify problems and make timely improvements to improve the platform's user stickiness and reputation.

6.2.4. Cost-effectiveness assessment

It is first necessary to assess the costs of constructing and operating the smart village platform, including the development and maintenance costs of AI technology, the application and management costs of blockchain technology, and the procurement and operation costs of IoT equipment. The cost-effectiveness of the project will be assessed by comparing these costs with the economic benefits brought by the programme.

6.2.5. Assessment of economic benefits

Comparison of the economic returns from the location of agricultural products before and after the application of the Smart Rural Platform, which includes indicators such as productivity, product quality, sales, prices and farmers' incomes of agricultural products before and after the implementation of the programme.

6.2.6. Assessment of social benefits

Apart from economic benefits, it is also necessary to consider the social benefits brought about by the Smart Rural Programme. This includes benefits in terms of enhancing the quality of life of rural residents, promoting the transformation and upgrading of the agricultural industry, and promoting the development of rural tourism. These social benefits can also be assessed through certain indicators and research studies.

7. Conclusion and Outlook

Through in-depth analysis, this paper explores the application of blockchain, AI and IoT technologies in digital community group-buying platforms, and the comprehensive use of these technologies provides new ideas and solutions for the construction of smart villages. By building an efficient, transparent and secure community group-buying platform, we can not only solve the problems of backward infrastructure, information asymmetry and high logistics

costs faced by rural areas, but also promote the direct marketing of agricultural products, increase farmers' incomes, and promote the development of rural economy.

In the future, with the continuous progress and innovation of technology, the digital community group-buying platform will have more room for development. The construction and application of digital community group-buying platforms will inject new vitality into rural revitalisation and promote the sustainable development of rural economy. We expect that in the near future, these technologies will become more mature and popular, and bring rural residents a more convenient and enriched life experience.

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