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BLOCKCHAIN-ENABLED LOYALTY PROGRAMS

Blockchain technology offers transformative potential in loyalty programs by enhancing transparency, reducing fraud, and providing seamless cross-platform usage. This article focuses on the study of the usage of a blockchain-based loyalty model through game theory, focusing on customer retention and system efficiency. Using the Prisoner's Dilemma and Nash Equilibrium, the study will examine the definition of customer engagement patterns in tokenized loyalty structures. Preliminary findings indicate blockchain's advantages in preventing fraud and improving trust, which optimizes loyalty program effectiveness.

Keywords: *blockchain, smart contracts, loyalty program, game theory*

Traditional loyalty programs face challenges related to fraud, inefficiency, and difficulty in cross-platform integration, which impacts customer retention and satisfaction. Blockchain technology has the potential to address these issues effectively by providing a secure and transparent system.

Currently, traditional customer loyalty programs are facing such challenges as:

1. Fragmentation. Customers often have to deal with multiple loyalty programs from different companies, each with their own rules, rewards, and redemption methods. This can cause confusion and frustration for customers who may end up ignoring or forgetting about their loyalty points.

2. Lack of interoperability. Customers cannot easily transfer, redeem or combine their loyalty points across different programs or platforms. This limits their choices and reduces the value of their points.

3. High costs and inefficiencies. Businesses have to invest a lot of resources and infrastructure to manage and maintain their loyalty programs such as card issuance, transaction tracking, identity verification, and rewards processing. These processes can be prone to errors, fraud and delays, which can undermine customer satisfaction and trust [1].

Blockchain is "a distributed database that maintains a continuously growing list of ordered records, called blocks." These blocks are linked using cryptography. A blockchain is a decentralized, distributed and public digital ledger that is used to record transactions across many computers so that the record cannot be altered retroactively without the alteration of all subsequent blocks and the consensus of the network. It consists of data (a data about transaction as in bitcoin), hash (like a fingerprint id) and a hash of previous block [2].

One of the more recent blockchain developments is the creation of smart contracts. These contracts are simple programs that are stored on the blockchain and can be used to automatically exchange coins based on certain conditions.

In the model mentioned, the loyalty points are tokenized, allowing customers to earn and redeem points across various vendors within a blockchain network. This model offers decentralized tracking, where tokens are securely stored and exchanged on a distributed ledger. Unlike traditional systems, blockchain provides an immutable record, enhancing trust in point issuance and redemption, and preventing double-spending fraud [3].

The smart contract is often activated by the person who wants to make the exchange. Correct compliance with the terms of the smart contract is confirmed by the nodes in the network.

The smart contract technology can be schematically depicted as follows:

1. A person initiates a transaction.

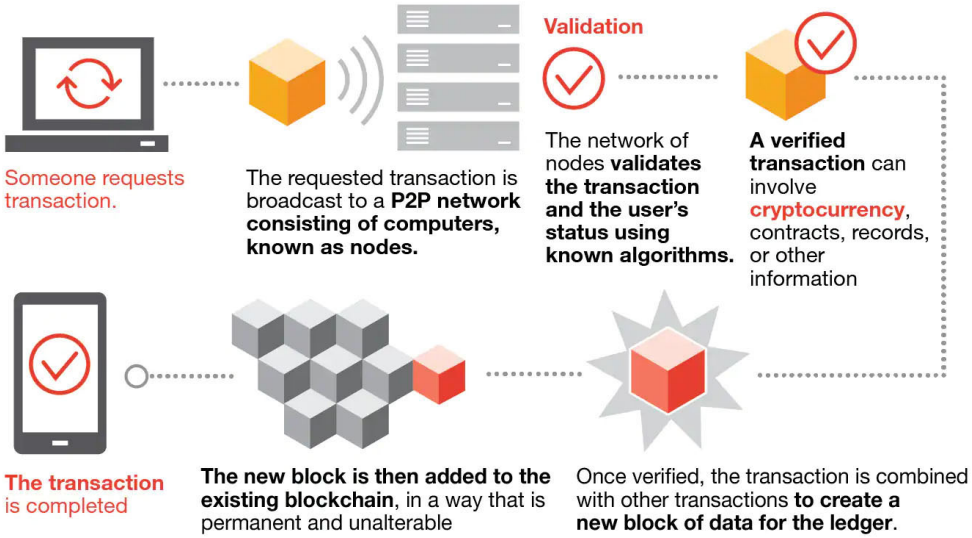
2. Information about the transaction enters a network consisting of nodes.

3. The nodes, based on certain consensus algorithms, confirm the initiator's status information and the transaction itself.

4. Once confirmed, the transaction becomes part of a new block forming, which includes other transactions.

5. The new block joins the block chain.

6. The transaction is complete [4].



Blockchain technology

In a blockchain-enabled loyalty system, smart contracts can automate key loyalty processes. For instance, when a customer makes a purchase, a smart contract can automatically issue loyalty points based on predefined rules, making the system more efficient and removing the need for manual intervention. Similarly, customers can redeem points through smart contracts, ensuring transparency and eliminating fraud risks like double-spending [5].

Smart Contract Benefits include:

1. Automation: Smart contracts ensure that rewards are issued and redeemed automatically based on predefined conditions, making the loyalty program more reliable.

2. Security: Each transaction is recorded on the blockchain, preventing tampering and ensuring both parties (business and customer) adhere to the rules.

3. Interoperability: Smart contracts facilitate seamless point transfer across different vendors, creating a more cohesive customer experience in multi-brand loyalty programs.

Applying Game Theory

Game theory is a branch of mathematics and economics that deals with the study of strategic interactions between rational decision-makers (players) in situations where the outcome of one player's choice depends on the choices made by other players.

To analyze customer interactions within this system, two game-theoretic models can be used:

Prisoner's Dilemma: In this scenario, customers can either cooperate by redeeming and earn-

ing points responsibly or defect by attempting to exploit the system (e.g., redeeming points fraudulently). Blockchain's transparency discourages defection by ensuring that all transactions are traceable, making it easier to detect malicious behavior. In this setup, cooperation (or responsible engagement) becomes a stable strategy as it maximizes long-term benefits for all parties.

Nash Equilibrium: By modeling loyalty interactions, we determine an equilibrium point where customers' utility is maximized in a balanced system. This is achieved when customers value the points sufficiently to continue participating without excessive demand on the business. Blockchain's immutable ledger ensures fairness, as all participants can verify transactions independently.

These models demonstrate that blockchain can create an environment where cooperation is incentivized, reducing risks of fraud and enhancing customer loyalty. Integrating game theory into these systems ensures that networks can operate securely and efficiently despite the lack of a central authority.

Implementing a blockchain-based loyalty system has several anticipated benefits:

1. Reduced Fraud: Blockchain's transparency and immutability prevent double-spending and other common forms of loyalty fraud, which improves the program's efficiency and trustworthiness.

2. Enhanced Customer Trust and Engagement: As customers can verify their points and their transactions independently, their trust in the loyalty program increases, which fosters long-term engagement.

3. Operational Efficiency: Blockchain allows seamless interoperability across vendors, which can streamline the customer experience and reduce administrative costs associated with managing traditional loyalty programs.

Singapore Airlines real-life examples

Singapore Airlines launched KrisPay, a blockchain based digital wallet that allows customers to convert their frequent flyer miles into credits. These credits can be spent at a wide range of partner merchants, from retail outlets to restaurants and gas stations. Blockchain technology ensures a secure and transparent process, giving customers more options to use their miles seamlessly across various sectors [6].

The decentralized structure enables KrisFlyer members to spend points easily, and merchant partners don't need to rely on traditional banking infrastructure for reimbursement, making the system faster and more reliable

At the launch, KrisPay partnered with 18 merchants across categories ranging from beauty and food services to gas and retail. The press release announcing KrisPay described it as "the world's first blockchain-based airline loyalty digital wallet"; revolutionizing the way customers could utilize their loyalty rewards [7].

In conclusion, blockchain can play a vital role in loyalty programs and understanding customer behavior within these programs using game-theoretic model. Blockchain incentivizes customers to participate responsibly, ensuring transparency and security, which promotes customer retention. Game-theoretic approaches, combined with blockchain's unique properties, offer businesses a way to innovate loyalty systems effectively and ethically, potentially setting a new standard for customer loyalty and engagement. Further research could implement and test these models using real-world data from businesses with active loyalty programs.

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