**On Designing an Intelligent Shipping Algorithm for**

**Decentralized E-Commerce Systems**

Suneel Kumar 1,Sarvesh Pandey 2 and Umesh Bhatt3

1 Department of Computer Science, Institute of Science, BHU, Varanasi, UP, India

1,2Computer Science, MMV, BHU, Varanasi, UP, India

3 Indian Institute of Technology Madras, India

[1suneel@bhu.ac.in](mailto:1suneel@bhu.ac.in), [2sarveshpandey@bhu.ac.in](mailto:2sarveshpandey@bhu.ac.in) and 321f1001400@ds.study.iitm.ac.in

**Abstract**

The emergence of online shopping was driven by the objective of delivering consumer products through a streamlined and user-friendly digital platform. Numerous challenges exist in the process of transitioning customers from conventional brick-and-mortar retail methods to the online shopping paradigm. Also retaining customers for online purchasing is a challenge, the customers have to pay some extra amount as the product handling fee and shipping charges for an order. Various online grocery retailers offer to minimize shipping fees through the implementation of distinct purchasing policies. Typically a customer gets the product delivery charge-free if they place an order of more than the threshold value. The customer who places an order frequently but with less amount than the threshold will have to pay the delivery charge every time no matter the cumulative sum of the order crosses the threshold. In this paper, we have a major focus on three points- 1. To make a fair ground for the sellers who intend to sell a product(s) that costs much less than a free shipping threshold. 2. To encourage those customers who prefer to buy more frequently with lesser order values. In opposite these existing policies, (i.e. free shipping on orders above Rs. 500/-) force customers to place an order that costs more than the free shipping threshold which is not customer-friendly. 3. To develop an algorithm that favors both seller and customer which can eventually increase the revenue of e-commerce websites like Flipkart, and Amazon.in, Myntra.

To meet our objective, we have used the TPC-H standard data set. We use the blockchain paradigm to solve this problem in which the ordered transaction is stored in the blocks and a generated new block is appended to the blockchain.

**Keywords: TPC-H, Blockchain, Intelligent Shipping, Smart Contract**

# **Introduction**

In the last few years, the technology underlying Bitcoin called Blockchain has received remarkable attention from the industry as well as academia. Blockchain is a technology that uses distributed records called a ledger, integrates consensus mechanism, decentralized data storage, encryption algorithm, peers, and use of computers to build new technology. Each peer in the network has a copy of all records. Within the blockchain, the concept of a chained structure serves to render the system both immutable and transparent. In recent times, the application of blockchain technology predominantly focuses on the financial sector, but it also has led the tremendous changes in the non-financial sectors like e-commerce, e-government, supply chain, and credit evaluation.

A network of organizations and individuals involved in the production of products and their delivery to the end user is termed a supply chain. The network is built up with the producer, warehouse IN, Transportation, warehouse OUT, retailers, and end-user (consumer). Nowadays, the network is spread worldwide. Supply chain management is the strategic and systematic coordination of the various components within the supply chain to ensure efficient, effective, and cost-effective operations. There are several problems in flowing the information among users, retailers, suppliers, and manufacturers related to security, transparency, and trustworthiness. The lack of transparency in the supply chain information results in a deficit of trust between parties and hampers operations. Product tracking becomes challenging, particularly in cases where counterfeit and substandard products emerge. To encounter such types of problems blockchain technology is best suited. Blockchain technology, while facilitating information transmission, ensures traceability, and authenticity, and provides a secure transaction in a distributed environment.

With the rapid development of online shopping, e-commerce platforms try to attract more and more consumers to purchase products from their respective shopping websites. To reach their primary objectives, suppliers promise to fulfill the user’s requirements.

The E-commerce industry is predicted to surpass sales of $8 Trillion in 2026. Since 2020, the global COVID-19 pandemic-induced lockdowns have significantly catalyzed the expansion of the e-commerce sector. The analysis of data from the U.S. Department of Commerce shows that online consumer expenditure increased by 32.4% year over year in 2020 [2]. The transition from the traditional grocery system to the online grocery system is that online grocery shopping serves its customers and manages home delivery. The consumers find the platform where they can get benefits maximum in terms of product price, product quality, services, and delivery charges. In a traditional pricing model, users are entitled to complimentary delivery services when placing orders for high-priced products. When users engage in multiple transactions involving low-cost items, they are subject to incurring delivery charges with each individual order. Why do they receive incentives in terms of delivery charges?

Milton [3] asserts that the prevailing practice among online grocery retailers involves soliciting a delivery fee that amounts to only 80% of the total delivery cost. There is no doubt that online grocers will not charge handling costs and internal shipping with customers. For instance, Whole Foods Market (WFM) announced free delivery for 2 hours in 2017 through Amazon Prime. Since October 25, 20121, WFM has been charging a delivery fee of $ 9.95 on every order to cover the handling cost associated. The shipping policy used by the grocer directly impacts the consumer's behaviors. The report [4] indicates that 95% of purchase decisions made by online consumers in the United States are influenced by shipping costs, with 63% of these decisions identified as primarily attributable to the abandonment of their shopping carts.

The online grocer uses a different strategy to mitigate the impact of the shipping cost and to motivate and retain more customers. For example, the goods and food delivery company Gopuff, which operates in the US and England, charges a flat fee of $1.95 for each delivery. Walmart Grocery and Kroger Delivery charge a flat rate fee depending on the user's location and delivery speed. Yamibuy, Wee, Hungryroot, Walgreen, etc. online grocers implement the CFS (contingent free shipping). According to this policy, consumers are exempt from the delivery fee when their order value surpasses a specified threshold otherwise they incur a fixed-rate shipping fee. The marking analysis says that consumers typically do not make decisions about purchasing on the basis of total price when product cost, handling cost, and shipping fee are separately charged.

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**Smart Contract**

A simple contract is a legally binding agreement between two or more parties wherein they mutually commit to specific obligations or actions in the future. An ordinary contract is referred to as a "smart contract" when it incorporates automated and self-executing functionalities in accordance with the terms and conditions specified in the agreement. Its primary characteristic is its capacity to eliminate the need for third-party intermediaries and establish trust through self-execution. For instance, John obtained a loan from a bank and entered into a contractual agreement with the bank. This agreement stipulates that the bank will automatically deduct a predetermined sum from his bank account at the end of each month when his salary is deposited. The computer program responsible for automatically deducting John's salary from his account by verifying and executing all the terms and conditions of the agreement is referred to as a smart contract.

# **Related Work**

In this part of the paper, we will describe the most significant rating and grading system based on blockchain.

The rapid growth in communication technology development is driven by the increasing demand for sharing information and data across various sectors. The tourism sector requires communication technology to share views and data about tourist destinations so that new tourists can get an experience in finding their intended tourism destinations. However, the information and data related to the ranking of tourist places are exchanged through a central server. Centralized architecture has many limitations that are required to improve. The research article represents a TDRS (Tourism Destination Rating System) which has 6As (Accessibility, Attractions, Available Packages, Amenities, Activities, and Ancillary Services) TD metrics to assess the tourism destination. The review of the destinations is shared on the mobile device of each traveler connected to the blockchain network. The model has been tested on many tourists [4].

Today’s publishing system is suffering from many issues like long publishing delays, and no fair financial credit distribution among the contributors. EUREKA is an open-access publishing platform laced with blockchain technology that provides fair credits to all publishing contributors directly via smart contracts. There are different interfaces for the authors and reviewers, the writer can submit the article. The judges who review the articles can give their opinions on the acceptance or rejection of the articles and all the events are going to be executed through the Ethereum smart contract [5].

A circular economy focuses on the regeneration of resources rather than possession and suggests leveraging shared resources to build new economies and new supply networks. Before collaborating on the circular economy, each entity must have the credit rating of the other. In this referenced paper blockchain technology has been applied to transactions that occurred corresponding to the economic entity and a confidence level method estimates the credit rating of each entity. The system provides a decentralization environment to optimize the third-party involvement costs and enables to conduct of credit ratings effectively [6].

Selecting a reliable shopping website is a challenging task for a user. The supplier and users may have different points of view regarding the product quality, leading to disputes between users and merchants. Purchasing the product based on images of the product or purchasing the product based on the merchant’s claim to have a high-quality product may cause disputes. This dispute cannot be removed completely but can be optimized up to a certain limit, no matter the reputable companies even Amazon.com and Alibaba.com, a user selects even. In all analysis conclusions, the reason for this problem is that the merchants do not evaluate the product based on the ratings. This paper proposes a grading system BPGS (Blockchain-based Product Grading System) through which a customer can purchase a genuine product dealing with big data of business. Additionally, under the planned BPGS, 51% of assaults cannot be successful unless 51% of the alliance's retailers and e-commerce businesses are concurrently penetrated [7].

Extensive research and analysis have been conducted to comprehend the mood and behavior of customers in the realm of online shopping. Researchers systematically analyze and endeavor to ascertain the factors influencing shoppers' behavior. These factors have a direct and immediate impact on the sales quantities. Two ordinary models have been developed with the dataset taken from the Kaggle repository which estimates the effect of online revenue collections and vising time in making the decision to purchase the products. The result shows that, although time spent on the website was completely insignificant, time spent on the mobile application did have a minor impact on sales (R2 = 0.249) [8].

Online shopping users’ personal information plays a very important role in driving an eCommerce business. It can be proved a significant element in differentiation among the organizations in the competition of business and also may provide a well-defined strategy to provide more profits for the organizations. However, there is a challenging worry about the requirement of consumer data and the security of the user’s desire for privacy. This research article explains both favorable and adverse effects on consumers' perceptions of privacy and trust. Also, a model of 301 online users has been tested who go through two online shopping websites and use one of them. The result is more oriented toward the positive effects on trust in privacy and websites. The idea of a positive mood in users’ behavior toward the features of the website has the potential to direct the creation of websites for efficient data collecting and information sharing [9].

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| **Author** | **Reward system type(tx based, threshold based)** |  | **Decentralization** |
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# **Methodology**

## **Proposed work**

### **Workflow components**

1. Users – It is a person who
2. Initial Order –It contains data related to user orders.
3. Final Order – In addition to the initial order it contains a free delivery field.
4. Blockchain – It is a chain of blocks containing orders as transactions.

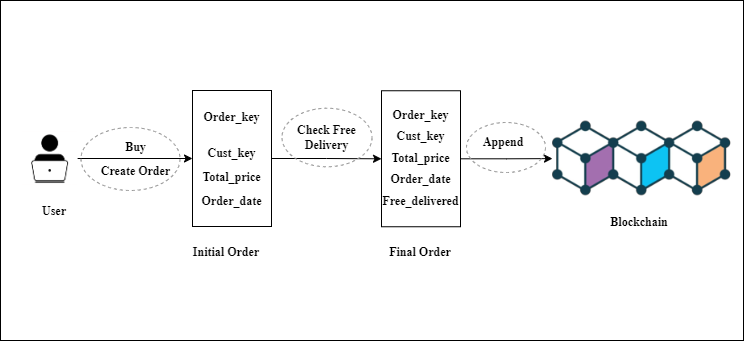
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Figure 1: The workflow of the proposed work

### **Workflow**

1. Buy – A user buys an item by sending order data using the buy function and creates initial order that contains the attributes –

* Order\_key
* Cust\_Key
* Total\_price
* Order\_date

1. Check – Buy function will call the Check\_delivery function sending (Cust\_id, Price, Date) to check whether the order is eligible for free delivery or not.
2. Append- The buy function will call the append function to append the transaction to the chain.

**ChainAlgo Pseudo code**

|  |  |
| --- | --- |
| **Input:** | **Order(Cust\_ID, Price, Time)** |
| 1 | total ← 0; flag←0; |
| 2 | For each Tx in Chain |
| 3 | If ( Order. time - Tx.time ) ≤ (1 Year) |
| 4 | If ( Order.cust\_ID ==Tx.cust\_ID) |
| 5 | If Order.Free\_delivered==FALSE |
| 6 | total← total+Tx.price |
| 7 | Else |
| 8 | flag←1 |
| 10 | Else |
| 11 | flag←1 |
| 12 | If (flag==1) |
| 13 | break |
| 14 | If total + Order.price ≥ Threshold |
| 15 | Return TRUE |
| 16 | Else: |
| 17 | Return FALSE |

# **Performance Results**

## **Simulation setup**

The experiment setups to exercise the proposed ideas and demonstrate the result, we have taken two environments:

1. Remix IDE for the smart contract of the proposed idea.
2. **Visual Studio Code IDE with Python Language to analyze the results**

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Figure 2: Performance comparison of our proposed algorithm ChainAlgo with Naïve algorithm

Explanation:

In Figure 2, we have compared the total number of orders eligible for free delivery assigned by both algorithms. The blue bar graph represents the naïve existing algorithm while the orange bar graph represents our proposed ChainAlgo algorithm. In the Bar graph, on the X axis, we have considered the total number of orders bought from the customer, and the Y axis signifies the total number of orders eligible for free delivery. The bar graph depicting performance data reveals that our newly proposed algorithm outperforms the current algorithm in terms of delivering free services to customers. For instance, at the 50K number of orders, the naïve algorithm delivers 12510 number ordered products without shipping fees while on the other hand, our proposed algorithm delivers 25264 ordered products without paying any delivery charges which is nearly double in number to the existing naïve method.

# **Conclusion and Future Work**

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