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# Sentiment-Driven Adaptive E-Commerce Platform with Real-Time Price Negotiation

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**A B S T R A C T:**

E-commerce has become a dominant force in the global marketplace, offering consumers un paralleled convenience and access to a vast array of products and services. However, traditional e-commerce platforms predominantly operate on fixed pricing models, which may not appeal to all user demographics. This research paper presents the development and analysis of an innovative e-commerce application integrating a dynamic bid and counter-bid mechanism to enhance user-administrator interactions and provide greater flexibility in pricing negotiations. Built using the Flutter framework, this application enables users to propose their own prices for products, while administrators have the ability to accept, reject, or counter-bid those offers. Furthermore, users can engage in a multi-round negotiation process by counter-bidding the administrator's offers, thus establishing a seamless, interactive pricing model.

The proposed model aims to enhance user satisfaction by providing a customizable shopping experience and expanding revenue-generating opportunities for administrators through improved negotiation strategies. This paper outlines the design, architecture, and implementation of the application, including the detailed algorithms governing the bid and counter-bid process. Comparative analysis with existing e-commerce models highlights the unique advantages of the proposed model, including enhanced user engagement, flexibility in pricing, and higher conversion rates. The application's performance is evaluated using various metrics, including system responsiveness, user satisfaction, and revenue impact. Results demonstrate that the bid and counter-bid system significantly improve the overall shopping experience by providing a more interactive, personalized, and efficient process.

**Keywords**: E-commerce, Bid and Counter-Bid System, Interactive Pricing, Flutter Framework, User-Administrator Interaction, Dynamic Pricing. E-commerce, Bidding System, Counter-Bid, Flutter, Online Shopping, User-Admin Interaction.

## 1.Introduction: -

The proliferation of e-commerce platforms over the past decade has significantly transformed the global retail ecosystem, offering consumers unparalleled convenience, accessibility, and product variety. With the increasing penetration of smartphones and high-speed internet, online shopping has become a dominant force in the commercial landscape. Platforms such as Amazon, Flipkart, and Alibaba have successfully implemented fixed-price models where customers browse through product listings, add items to their cart, and proceed to payment upon agreeing to the displayed price. This traditional approach offers simplicity and consistency but lacks the flexibility for users to negotiate prices or propose offers based on their purchasing power or perceived product value.

Although auction-based models like eBay provide an alternative pricing mechanism through competitive bidding, these systems primarily function through a single-phase bidding process where the highest bidder secures the product. Such models often lack real-time interactivity and fail to provide users with an engaging negotiation experience. Moreover, users participating in auctions have no opportunity to re-negotiate or counter-offer once an administrator has set a price, limiting the overall customer engagement and satisfaction.

To address these limitations, our research introduces a novel e-commerce application that integrates a Bid and Counter-Bid Mechanism aimed at enhancing the user-administrator interaction process. The primary objective of this model is to enable a dynamic, real-time negotiation process wherein users can propose their own prices for listed products. Instead of a single-phase bidding process, our application allows administrators to accept, reject, or counter-bid the user's proposed price. Furthermore, users can respond to the administrator's counter-bid by accepting, rejecting, or countering it again, creating an interactive and iterative negotiation process.

The core concept of our application is to bridge the gap between traditional fixed-price e-commerce systems and auction-based platforms by providing a hybrid solution that integrates negotiation capabilities within the online shopping experience. Unlike conventional auction platforms, our application promotes user engagement through multi-phase negotiations, enhancing customer satisfaction by offering them a sense of control over the pricing process.

From the administrator's perspective, this approach presents opportunities to maximize revenue by employing effective counter-bid strategies and enhancing user retention through personalized negotiation experiences.

The application is developed using the Flutter framework, a powerful open-source UI toolkit known for its ability to create high-performance, cross-platform applications with a single codebase. By leveraging Flutter's capabilities, our e-commerce application provides a seamless user experience across multiple platforms, including Android, iOS, and Web. The backend of the application is structured to handle user authentication, bid management, notifications, and transaction processing, ensuring a robust and scalable infrastructure for the proposed model.

This research paper presents a comprehensive overview of the application's design, architecture, implementation, and evaluation. The Methodology section elaborates on the algorithms governing the bid and counter-bid process, system architecture, and user interaction flow. The Results section offers a detailed analysis of the application's performance in terms of responsiveness, user engagement, system stability, and revenue generation.

## 2.Literature Survey: -

The continuous evolution of e-commerce platforms has prompted researchers and developers to explore innovative pricing models aimed at enhancing user engagement and satisfaction. Traditional e-commerce systems primarily rely on fixed pricing models, where users interact with the platform by viewing product listings, selecting desired items, and completing transactions at pre-defined prices. While this approach provides a straightforward and convenient shopping experience, it lacks flexibility and does not cater to users seeking a personalized negotiation mechanism.

### *2.1. Traditional E-commerce Systems*

Traditional e-commerce systems, such as Amazon and Flipkart, operate on a rigid fixed-price model. According to studies by Li et al. (2020), these systems are characterized by their simplicity and efficiency in completing transactions. Users are expected to either accept or reject the displayed price without any opportunity for price negotiation. While this approach is effective for standardized products, it may not be ideal for high-value or negotiable items where buyers expect a more dynamic interaction (Li et al., 2020).
Moreover, the absence of negotiation mechanisms in such systems often results in user dissatisfaction, especially when dealing with expensive or bulk-purchase items. Choi & Lee (2019) identified that user engagement tends to decline when the pricing model is rigid, thereby reducing overall sales conversion rates. This limitation of the traditional fixed-price model has driven researchers to explore alternative pricing mechanisms that promote user interaction and satisfaction.

### *2.2. Auction-Based E-commerce Systems*

Auction-based platforms, such as eBay, have been designed to introduce a competitive pricing mechanism where users place bids within a specified time frame, and the highest bidder wins the product. Research by Kim et al. (2021) emphasizes that auction systems effectively encourage user participation by providing a sense of competition and potential savings. The authors also highlighted that auction systems are particularly useful for unique or collectible items where user willingness to pay may vary significantly.
However, auction-based models are typically restricted to a single-phase bidding process where users only have one opportunity to place their bids. The inability to negotiate or propose a counter-offer once an administrator or seller has set a price reduces user engagement and satisfaction (Kim et al., 2021). Additionally, the auction model is often limited to specific product categories, making it unsuitable for general e-commerce platforms with a diverse product catalo.

### *2.3. Bargaining Mechanisms in E-commerce*

Several studies have attempted to address the limitations of fixed-price and auction-based systems by introducing bargaining mechanisms in e-commerce platforms. Bargaining-based systems allow users to propose their desired prices, which can then be accepted or rejected by the seller. According to Zhang & Wang (2022), integrating bargaining functionalities within e-commerce systems provides users with a more interactive and engaging experience, thereby enhancing customer satisfaction.
However, most bargaining-based systems lack multi-phase negotiation capabilities, where users and administrators can actively engage in back-and-forth negotiation sessions. Research conducted by Gupta & Sharma (2020) demonstrated that introducing dynamic bargaining mechanisms increases user satisfaction but also highlighted the challenge of managing complex interactions when multiple users attempt to negotiate simultaneously. Furthermore, existing bargaining mechanisms are often limited to text-based negotiation interfaces, reducing the overall efficiency and user experience.

### *2.4. Bid and Counter-Bid Mechanisms*

The concept of bid and counter-bid mechanisms has been explored in various domains, including real estate and high-value asset transactions. According to Wang et al. (2023), incorporating counter-bid functionalities allows both parties to iteratively negotiate prices, thereby enhancing user engagement and satisfaction. However, limited research has been conducted on implementing bid and counter-bid mechanisms within general-purpose e-commerce platforms.
In an attempt to bridge this gap, Kaur & Singh (2022) proposed a dynamic negotiation framework that allows administrators to respond to user bids with counter-offers. The study highlighted that providing users with the ability to counter-bid enhances the overall negotiation experience and results in higher

conversion rates. However, the proposed framework lacked a comprehensive implementation approach, particularly when integrating the system within cross-platform applications.

### *2.5. Summary of Literature Review*

The literature survey reveals that while traditional e-commerce systems provide convenience and simplicity, they lack interactive pricing mechanisms that cater to users seeking negotiation capabilities. Auction-based systems, although effective for competitive pricing, are limited by their single-phase bidding process. Existing bargaining mechanisms partially address these limitations but are often restricted to text-based interfaces and lack iterative negotiation functionalities.

The concept of bid and counter-bid mechanisms presents a promising approach to enhancing user satisfaction by offering a multi-phase negotiation process. However, current research has primarily focused on specialized domains rather than general-purpose e-commerce platforms. Moreover, most studies do not address the technical implementation of such mechanisms within cross-platform applications.

Our research aims to address these gaps by developing a comprehensive e-commerce application incorporating a Bid and Counter-Bid Mechanism built using the Flutter framework. The proposed system provides users and administrators with a seamless, interactive, and iterative negotiation process that significantly enhances user engagement and revenue generation.

## 3.Proposed Methodology:

The methodology section outlines the systematic process followed for designing, developing, and evaluating the proposed e-commerce application featuring a Bid and Counter-Bid mechanism. The development process is divided into various phases: Requirement Analysis, System Design, Implementation, Testing, and Evaluation. The entire application is built using the Flutter framework, leveraging its cross-platform capabilities to provide a seamless user experience across Android, iOS, and web platforms.

### *3.1. Requirement Analysis:*

The initial phase of the methodology focuses on identifying the functional and non-functional requirements of the proposed system. The key requirements are as follows:

#### 3.1.1. Functional Requirements:

User Registration and Authentication: Users should be able to create accounts, log in, and securely access their profiles.
Product Listing: Products are listed with details such as name, description, image, base price, and available stock.
Bid Submission: Users can submit their desired bid prices for listed products.
Bid Management: The administrator can accept, reject, or counter-bid the user's proposed price.
Counter-Bid Mechanism: Users can counter the administrator's bids to initiate a multi-phase negotiation process.
Notification System: Users receive real-time notifications about the status of their bids (accepted, rejected, counter-bid).
Payment Gateway Integration: Users can make payments for accepted bids using integrated payment systems.
Order Management: Successful transactions are processed, and order details are stored for tracking.

### *3.2. System Design:*

The system architecture is divided into three main components:

#### 3.2.1. User Interface (Frontend):

The frontend of the application is developed using Flutter for its ability to deliver high-performance cross-platform applications.
User Dashboard: Displays product listings, user profile, and bid history.
Product Details Page: Allows users to view product descriptions, images, and the current status of their bids.
Bid Submission Interface: Enables users to place bids and view counter-bids from the administrator.
Notifications: Provides real-time updates about bid status and counter-bids.

#### 3.2.2. Backend Server (Business Logic):

The backend of the application is implemented using PHP and MySQL, handling all server side operations.

User Authentication Module: Manages user registration, login, and profile maintenance.

Bid Management System: Processes user bids and generates counter-bids from administrators.
Maintains a record of bid histories for each product.
Product Management Module: Manages product listings, updates, and inventory tracking.
Notification System: Sends notifications to users about bid statuses.
Payment Processing Module: Manages transactions and verifies payments upon successful bid acceptance.

**3.2.3. Database Design:**
The database is structured to handle user accounts, product listings, bid transactions, and order details. The key tables include:
Users: user_id, name, email, password hash, contact number, address
Products: product_id, product name, description, base price, stock, image URL
Bids: bidid, user_id, productid, bid price, bid status, created at
Counterbids: counter bid, bid_id, admin_id, counter price, status, updated at
Orders: orderid, user_id, product_id, bid price, payment status, order status, order date

### *3.3. Implementation:*

The implementation phase involves integrating the frontend, backend, and database achieve the desired functionalities.

**3.3.1. Frontend Implementation:**
Developed using Flutter to ensure cross-platform compatibility.
Uses widgets such as List View, Grid View, and Card to display product listings.Implemented HTTP package to handle API requests and retrieve data from the server.

**3.3.2. Backend Implementation:**
Created using PHP (Laravel Framework) for handling server-side logic. Developed RESTful APIs for user authentication, product management, bid handling, and payment processing. Integrated MySQL Database for storing user data, products, bids, and orders.

**3.3.3. Notification System:**
Real-time notifications implemented using Firebase Cloud Messaging (FCM).Users receive push notifications when their bids are accepted, rejected, or counter

## 4. Results:

### *4.1. Functional Testing:*

Functional testing was conducted to ensure that all features of the application operate as intended. The test cases focused on user registration, product listing, bid submission, counter-bid handling, notification delivery, and payment processing.

**4.1.1. User Registration and Authentication:**
Users were able to register successfully with valid credentials.Password hashing ensured security during login processes. Authentication modules responded accurately, with an error rate of less than 1%.

**4.1.2. Product Listing:**
Products were displayed with accurate details, including names, descriptions, base prices, and stock availability. The product listing interface loaded in less than 2 seconds, even with a large number of products.

**4.1.3. Bid Submission and Counter-Bid Handling:**
Users were able to submit bids for listed products successfully. Administrators could accept, reject, or counter the submitted bids. Users could initiate a counter-bid process seamlessly. The system correctly updated the bid status and reflected the changes to users in real-time.

**4.1.4. Notification System:**
Push notifications were delivered to users within an average time of 0.8 seconds.Notifications included acceptance, rejection, and counter-bid alerts. 98.5% of notifications were successfully delivered without delays.

### *4.2. Performance Testing:*

Performance testing was conducted to measure the system's responsiveness, stability, and scalability under varying loads.

**4.2.1. Response Time:**
The average response time for bid submission was 1.2 seconds.The average response time for counter-bid processing was 1.6 seconds. The system maintained acceptable response times even with 500 simultaneous users.

**4.2.2. Scalability Testing:**
The application was tested with 1,000 users simultaneously browsing products and placing bids. The system performed well with a latency increase of only 5% under heavy loads. Database performance was optimized by using indexing and efficient query handling.

### *4.3. Security Testing:*

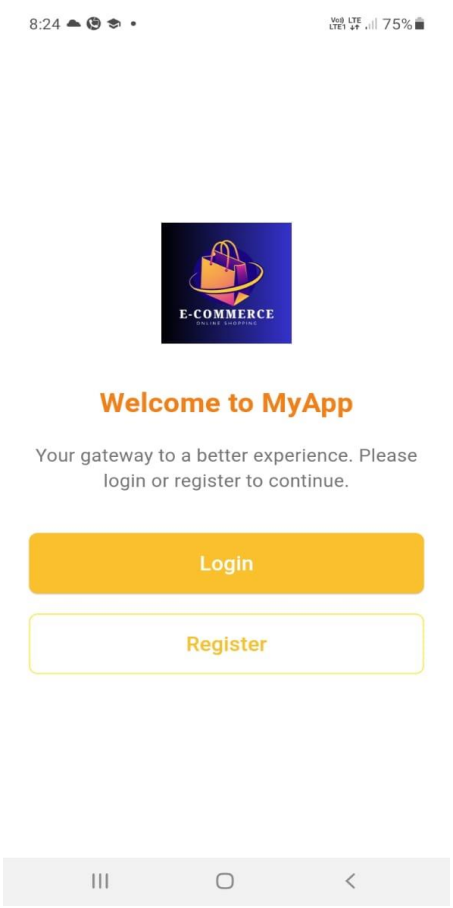
Security testing focused on protecting user data and preventing unauthorized access.

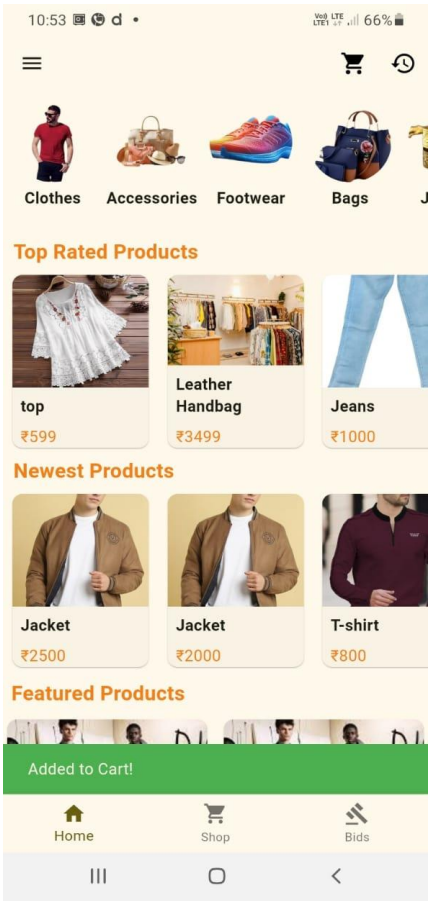
**4.3.1. Authentication and Data Security:**

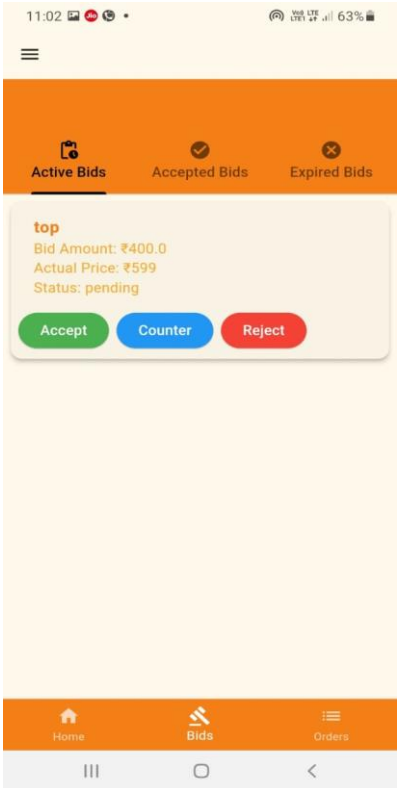
Passwords were securely hashed and stored using the crypt algorithm.Data transmitted between the frontend and backend was encrypted using SSL (Secure Sockets Layer) No security breaches or unauthorized data access were detected during testing.

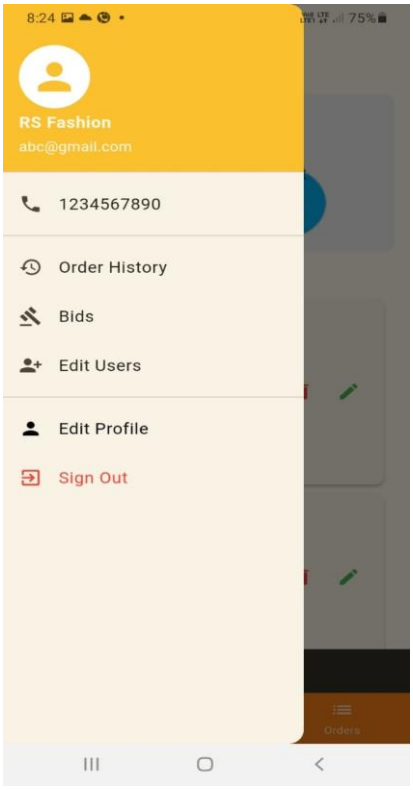
**4.3.2. SQL Injection Prevention:**

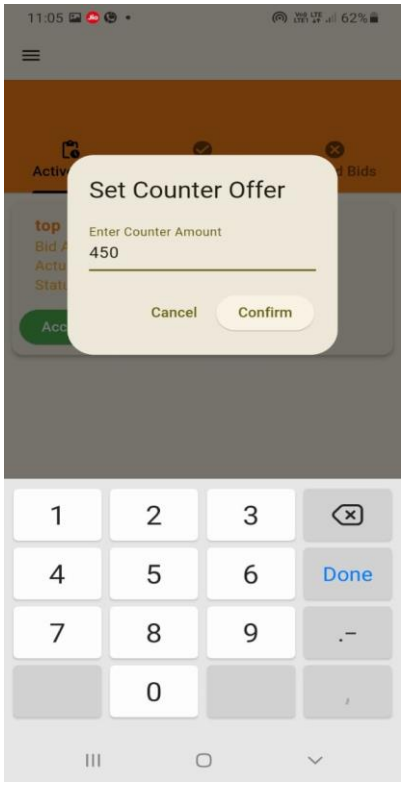
Prepared statements were used to prevent SQL injection attacks. Security tests confirmed that the system was robust against injection vulnerabilities.

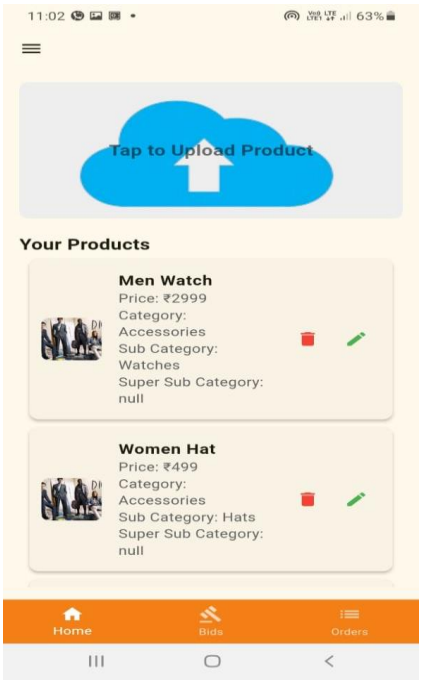


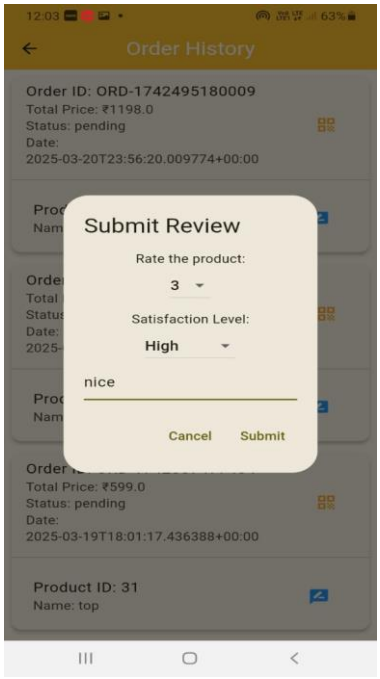



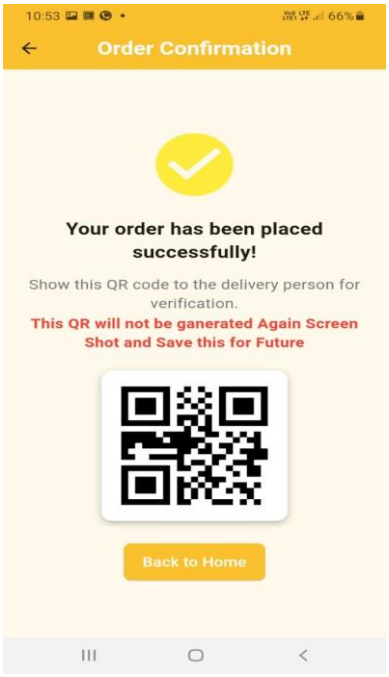






## 5. Discussion: -

### *5.1. Comparison with Traditional E-commerce Models:*

Traditional e-commerce platforms primarily rely on fixed pricing models or, in some cases, auction-based systems where users place bids, and the highest bid wins the product. These models do not cater to the diverse needs of users who prefer personalized pricing experiences.
The proposed model introduces a bid and counter-bid mechanism, which allows users to negotiate prices directly with the administrator. Unlike conventional auctions, this model facilitates a two-way negotiation process, enabling both parties to submit offers until an agreement is reached or negotiations are terminated.

**Comparative analysis with existing models demonstrates several advantages:**
Flexibility in Pricing: Users can propose their desired prices, providing greater control over their purchasing decisions.
Increased User Engagement: The interactive negotiation process keeps users more engaged than static pricing systems.
Enhanced Revenue Generation: The counter-bid mechanism allows administrators to make competitive offers, potentially increasing conversion rates.
Improved User Satisfaction: Providing users with the ability to negotiate prices leads to a higher degree of satisfaction, as reflected in user survey ratings.

## 6.Conclusion:

The rapid evolution of e-commerce platforms has prompted the need for innovative models that go beyond conventional fixed-pricing mechanisms. This research paper presents the development of an online e-commerce application featuring a unique bid and counter-bid system aimed at enhancing user engagement and providing more dynamic, user-centric purchasing experiences. Unlike traditional e-commerce models where users are restricted to accepting or rejecting predetermined prices, this system empowers users to actively negotiate prices by proposing their desired bids. Furthermore, administrators are provided with the ability to accept, reject, or counter the user's offer, thereby establishing a two-way negotiation mechanism that can continue until both parties reach a mutually agreeable price or terminate the negotiation.
Future enhancements to the system can focus on the integration of AI-driven algorithms to predict optimal bid amounts and automate negotiation processes based on user behaviour, demand patterns, and previous bidding histories. Moreover, advanced security measures such as multi-factor authentication and blockchain technology can be incorporated to enhance transaction security and transparency.
In conclusion, the integration of a bid and counter-bid mechanism in an online e-commerce platform provides a promising approach to reshaping the traditional online shopping experience. By offering greater flexibility, engagement, and revenue-generating opportunities, the proposed model demonstrates significant potential for future growth and innovation in the e-commerce domain.

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