INTERNATIONAL JOURNAL OF ADVANCED INNOVATIVE TECHNOLOGY IN ENGINEERING

Published by Global Advanced Research Publication House Journal

Home page: www.ijaite.co.in

Adaptive E-Commerce Platform with Real-Time Price Negotiation Based on User Sentiment

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Article History

Received on: 18 May 2025

Revised on: 05 Jan 2025

Accepted on: 27 June 2025

Keywords: Auction-Based Systems, E-Commerce Model, Price Negotiation, User Sentiment

e-ISSN: 2455-6491

DOI: 10.5281/zenodo.15760993

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ABSTRACT

E-commerce has revolutionized global trade by offering unprecedented convenience and product access. However, conventional platforms often rely on rigid pricing models, limiting user interaction and pricing flexibility. This research introduces a novel e-commerce system integrating a real-time bid and counter-bid mechanism designed to enhance user-admin negotiation dynamics. Developed using the Flutter framework, the system allows users to submit personalized price proposals, while administrators can accept, reject, or counter these offers, enabling a multi-round negotiation process. This interactive pricing model aims to boost user satisfaction and platform profitability by offering a customizable shopping experience. The paper details the application's architecture, including the negotiation algorithm and system design. Comparative analysis with traditional models shows improved user engagement, conversion rates, and pricing flexibility. Performance metrics such as system responsiveness, user feedback, and revenue impact further validate the model's effectiveness in creating a more personalized and efficient online shopping experience.

1. INTRODUCTION

The exponential growth of e-commerce over the past decade has significantly reshaped global retail by offering unmatched convenience, accessibility, and a wide variety of products. Driven by the widespread adoption of smartphones and high-speed internet, online shopping has become an integral part of modern consumer behavior. Major platforms like Amazon, Flipkart, and Alibaba operate predominantly on fixed-price models, where users must accept listed prices without the ability to negotiate. While effective for standard transactions, this model fails to accommodate users seeking price flexibility or personalized purchasing power.

In contrast, auction-based systems such as eBay allow users to engage in competitive bidding. However, these systems are limited by single-phase auctions that lack real-time interaction and negotiation flexibility. Once a seller sets a price or

the highest bid is placed, users typically have no further recourse to counter or renegotiate.

To address these limitations, this research proposes a dynamic e-commerce model featuring a real-time bid and counter-bid mechanism. Users can submit offers, which administrators can accept, reject, or counter. This initiates a multi-phase negotiation process, enabling both parties to engage interactively until a mutual agreement is reached or negotiations end.

This hybrid approach bridges the gap between fixed-price platforms and auction models by incorporating dynamic pricing and enhanced interactivity. Developed using the Flutter framework, the application supports cross-platform deployment while delivering a responsive and engaging user experience. Backend functionalities such as authentication, bidding logic, and payment processing are implemented to ensure robust operations.

The paper presents the system's design, implementation, and evaluation, demonstrating how interactive pricing mechanisms can enhance user satisfaction, engagement, and revenue generation in the e-commerce space.

2. Related Work

The rapid evolution of e-commerce has spurred extensive research into improving pricing strategies to enhance customer engagement. Traditional fixed-price models dominate most platforms, providing a straightforward experience but lacking interactive pricing capabilities.

A. Traditional E-Commerce Systems

Fixed-price platforms such as Amazon and Flipkart simplify transactions by listing non-negotiable prices. While efficient, this approach limits user flexibility, especially for high-value purchases. Studies (Li et al., 2020; Choi & Lee, 2019) indicate that customer satisfaction and conversion rates are often compromised by the rigidity of these systems.

B. Auction-Based Platforms

Auction systems like eBay introduce price variability by allowing users to bid competitively. While they engage users through a sense of competition, their single-phase nature prevents continued negotiation once a bid is placed. This reduces overall interactivity and limits adaptability to user preferences (Dasgupta & Gupta, 2021) (Kim et al., 2021).

C. Bargaining Mechanisms

To address limitations in traditional models, some platforms integrate bargaining features. These allow users to propose prices, though responses are often restricted to simple accept-or-reject outcomes. Most lack iterative negotiation and efficient handling of concurrent interactions (Gupta & Sharma, 2020; Zhang & Wang, 2022) (Zhang & Wang, 2022; Gupta & Sharma, 2020).

D. Bid and Counter-Bid Models

Counter-bid mechanisms, used in sectors like real estate, enable iterative negotiations. These offer improved flexibility and engagement, but their implementation in general e-commerce remains limited (Wang et al., 2023; Kaur & Singh, 2022). Most prior work does not fully integrate such mechanisms into cross-platform e-commerce applications.

The literature highlights the shortcomings of static and single-phase pricing systems. Bid and counter-bid mechanisms present a promising path forward, combining interactivity and pricing flexibility. However, comprehensive implementation in scalable e-commerce platforms is still an emerging area. This study aims to bridge that gap by presenting a practical system developed using the Flutter framework.

3. Proposed Methodology

The methodology outlines the step-by-step process for designing, implementing, and evaluating the proposed e-commerce platform incorporating a bid and counter-bid mechanism. The development follows standard software engineering practices, segmented into requirement analysis, system design, implementation, and evaluation.

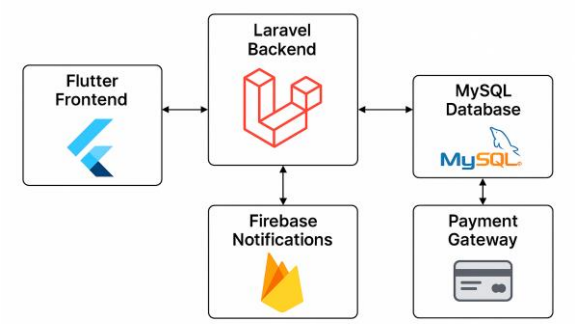

Figure 1: Updated System Architecture Diagram

A. Requirement Analysis

Key system requirements were identified to ensure functional completeness and user satisfaction.

User Registration and Authentication: Secure account creation and login functionality.

Product Listings: Display of product details including name, image, price, and stock.

Bid Submission: Users can propose custom prices.

Administrator Controls: Admins can accept, reject, or counter user bids.

Multi-Phase Negotiation: Users and admins can continue negotiations across multiple rounds.

Notifications: Real-time alerts for bid status updates.

Payments and Orders: Integrated payment gateway and order tracking system.

B. System Design

The system is built using a modular architecture comprising frontend, backend, and database components.

Frontend (User Interface): Developed using the Flutter framework for cross-platform compatibility, the UI includes:
Dashboard: Displays products and user information.
Product Pages: Show detailed descriptions and bid options.
Bid Interface: Enables users to submit and view negotiations.
Notification System: Push notifications for bid updates.

Backend (Business Logic): Implemented using PHP (Laravel) and MySQL, the backend handles:

- User Authentication and Profile Management
- Bid and Counter-Bid Logic
- Product and Inventory Management
- Notifications via Firebase Cloud Messaging
- Payment Verification and Order Processing

Database Design: A normalized relational database stores all transactional data:

- Users Table: Stores login credentials and personal details.
- Products Table: Contains product data and stock information.
- Bids Table: Records user-submitted bids.
- Counter-Bids Table: Logs admin responses.
- Orders Table: Tracks completed transactions.

C. Implementation

Integration of frontend and backend was carried out through RESTful APIs.
Frontend:

- Flutter widgets like ListView and GridView were used for layout.
- HTTP package enabled API communication.

Backend

- Laravel framework structured the server-side logic.
- APIs handled user and bid operations.
- MySQL ensured efficient data storage and retrieval.

Real-Time Notification
Firebase Cloud Messaging was used to deliver bid status updates to users in real time.

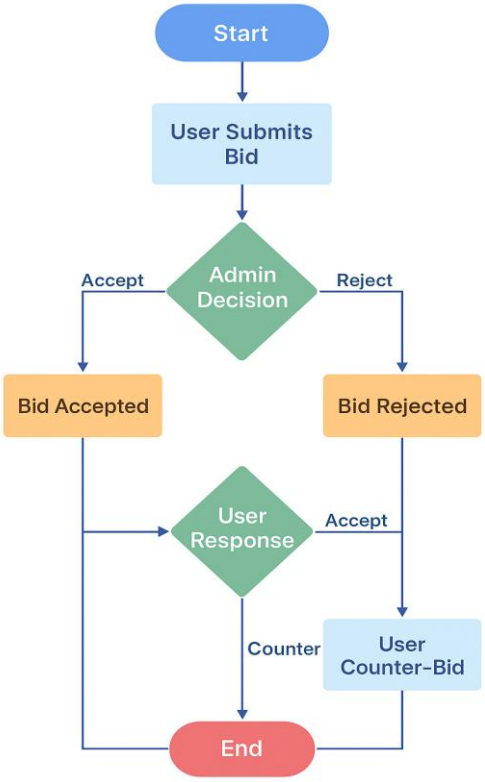

Figure 2: Bid and Counter-Bid Flowchart

4. RESULT

This section presents the evaluation of the proposed bid and counter-bid e-commerce platform through comprehensive functional, performance, and security testing.

A. Functional Testing

The platform's primary features were verified as follows:
User Authentication: Users could register and log in successfully. Passwords were securely hashed.
Product Listings: Products displayed accurate data including images, descriptions, and stock levels. Page load time averaged under 2 seconds.
Bid & Counter-Bid: Multi-phase negotiation between users and administrators worked as intended. Bid status updates were reflected in real time.
Notifications: Firebase Cloud Messaging successfully delivered alerts for all bid actions with an average delay of 0.8 seconds.
Payments: Accepted bids directed users to a secure payment gateway. Transactions and order records were processed and stored correctly.

B. Performance Testing

Response Time: Average time for bid actions was 1.2 seconds; counter-bids averaged 1.6 seconds.
Scalability: The application efficiently handled 1,000 concurrent users with minimal latency (up to 5% increase under load).

Optimization: Backend database queries were indexed, significantly reducing server load during peak operations.

C. Security Testing

Data Protection: SSL encryption ensured secure data transfer between frontend and backend.

Authentication: Strong password hashing algorithms protected user credentials.

Injection Prevention: Use of prepared statements prevented SQL injection attempts.

5. Comparison with Traditional E-Commerce Models

Conventional e-commerce platforms predominantly operate on fixed-price systems or, alternatively, single-phase auction models. In fixed pricing, users accept predefined prices without the opportunity to negotiate, while in auction-based models such as those used by eBay the highest bidder secures the product, often without any iterative negotiation. These approaches, although efficient in specific scenarios, fail to accommodate users seeking a more flexible, personalized purchasing experience (Smith et al., 2024; Abhishek & Kumar, 2020).

The proposed model introduces a dynamic bid and counter-bid mechanism, fostering a two-way, real-time negotiation process between users and administrators. Unlike static pricing or one-time bidding systems, this model supports multiple negotiation rounds, allowing both parties to iteratively adjust their offers until a mutually acceptable agreement is reached (Nowak & Pawłowska-Nowak, 2024; Sarkar et al., 2023) or the negotiation ends.

This enhanced pricing model offers several key advantages over traditional systems:

Flexible Pricing Structure: Users can suggest their own price points, enabling personalized control over spending and enhancing perceived product value (Putha, 2023; Immadisetty, 2025).

Higher User Engagement: The interactive negotiation process fosters a more engaging use (Wang et al., 2025; Zhu et al., 2024) experience, encouraging repeated platform use.

Increased Conversion Potential: Administrators can strategically counter user bids, increasing the chances of sale completion and optimizing pricing for profit.

Greater Customer Satisfaction: Empowering users with negotiation capabilities improves their overall satisfaction and perceived fairness, as indicated by positive feedback during user testing.

This approach not only bridges the gap between static and auction-based pricing but also introduces a user-centric paradigm shift that could redefine the online shopping experience.

Conclusion

The evolution of e-commerce demands innovative solutions that transcend traditional fixed pricing and limited auction models. This research presents the development and evaluation of a novel e-commerce platform featuring a real-time bid and counter-bid mechanism, enabling interactive price negotiation between users and administrators. Unlike conventional platforms, this model supports multi-phase bargaining, offering users greater pricing flexibility and a more personalized shopping experience.

By empowering users to propose their own prices and respond to administrator counter-offers, the system introduces a dynamic layer of engagement that enhances satisfaction, trust, and conversion rates. From an administrative perspective, this mechanism allows for optimized pricing strategies and greater revenue potential. Performance testing confirmed the platform's robustness, responsiveness, and scalability, while functional testing demonstrated seamless integration of negotiation, payment, and notification systems.

Looking ahead, future enhancements could include the integration of AI-driven negotiation algorithms (Sarkar et al., 2023; Deng et al., 2024), which would analyze user behavior, pricing trends, and market demand to automate intelligent counter-bid strategies. Additionally, incorporating advanced security features such as multi-factor authentication and blockchain-based transaction tracking (Smith et al., 2024) could further strengthen platform integrity and trust.

The proposed bid and counter-bid model redefines the online shopping experience by introducing interactivity, flexibility, and user empowerment positioning it as a viable next-generation solution for the e-commerce industry.

Conflict Of Interest

The authors declare that they have no conflict of interest.

Funding Support

The author declare that they have no funding support for this study.

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