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Intelligent Recommendation-Driven Auction Platform for Peer-to-Peer Trading

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ABSTRACT

With the increasing demand for efficient and sustainable peer-to-peer marketplaces, students and individuals often face challenges in trading underutilized goods such as textbooks, electronics, and furniture. Existing platforms lack personalized guidance and intelligent matching, resulting in inefficiencies and lost opportunities. This paper presents an Intelligent Recommendation-Driven Auction Platform for Peer-to-Peer Trading, which integrates a collaborative filtering-based recommendation system with an auction mechanism to optimize user experience and transaction efficiency. The platform predicts user preferences, suggests relevant items, and facilitates competitive bidding to ensure fair market pricing. Experimental evaluation demonstrates that the proposed system improves successful transaction rates, reduces search time for items, and enhances user satisfaction compared to traditional peer-to-peer marketplaces. The results indicate that combining recommendation algorithms with intelligent auction mechanisms can significantly enhance the effectiveness and sustainability of community-driven trading platforms.

KEYWORDS: *Peer-to-Peer Trading, Auction Platform, Collaborative Filtering, Recommendation System, Intelligent Marketplace*

INTRODUCTION

In university and community environments, students frequently possess valuable resources, such as textbooks, electronics, and furniture, which remain underutilized after graduation or course completion. Simultaneously, incoming or junior students often struggle to acquire these essentials at reasonable prices. The absence of a dedicated, intelligent peer-to- peer trading platform leads to inefficiencies, missed opportunities, and increased costs for students.

Existing peer-to-peer marketplaces offer basic buying and selling functionalities but lack personalized guidance, intelligent item matching, and fair pricing mechanisms. Users must manually search for items, often resulting in prolonged transaction times, reduced engagement, and suboptimal trades. Moreover, traditional auction-based systems do not consider user preferences, which limits the effectiveness of item recommendations and the overall user experience.

To address these challenges, this paper proposes an Intelligent Recommendation-Driven Auction Platform that leverages collaborative filtering to predict user preferences and recommend relevant items. The platform integrates a recommendation system with an auction mechanism to facilitate fair and efficient peer- to-peer trading. By combining personalization with competitive bidding, the system enhances transaction efficiency, maximizes resource utilization, and improves user satisfaction.

The main contributions of this work are as follows:
Design and development of a collaborative filtering- based recommendation engine for personalized item suggestions. Implementation of an auction mechanism that ensures fair market pricing and competitive trading. Evaluation of system performance in terms of transaction success rates, user satisfaction, and search efficiency.

The remainder of this paper is organized as follows: Section II reviews related work on peer-to-peer marketplaces and recommendation systems. Section III presents the proposed system architecture and methodology. Section IV details implementation and results. Finally, Section V concludes the paper and discusses potential future enhancements.

RELATED WORK

Peer-to-peer (P2P) marketplaces have been extensively studied in recent years due to their potential for enabling decentralized trading and efficient resource utilization. Early P2P platforms primarily focused on basic buying and selling functionalities, providing users with a platform to list and purchase goods without advanced personalization or intelligent matching [1]. These systems, while functional, often suffer from low user engagement and inefficiencies in locating relevant items [2].

To improve user experience, several studies have integrated recommendation systems into marketplace platforms. Collaborative filtering (CF) is one of the most widely adopted techniques for personalized recommendations, leveraging historical user-item interactions to predict user preferences [3]. CF approaches have been applied in e-commerce and auction-based systems to enhance user satisfaction, reduce search time, and increase transaction rates [5]. However, these systems rarely combine personalized recommendations with auction mechanisms, which are critical for determining fair market prices and encouraging competitive trading.

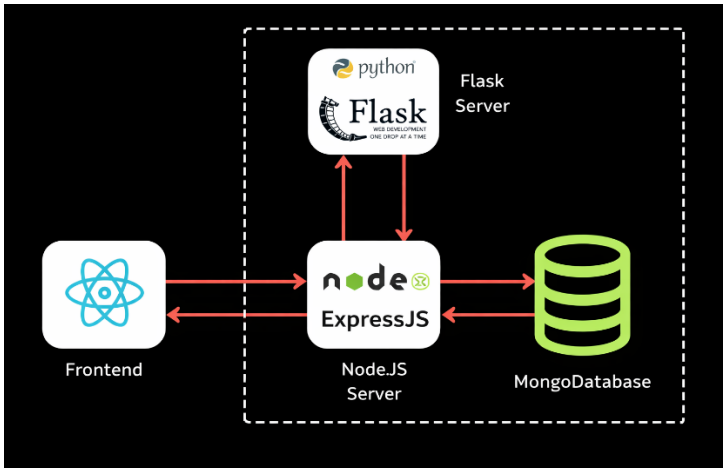
Auction-based platforms have been explored as a means to improve trading efficiency in peer-to-peer environments. Research demonstrates that integrating bidding mechanisms can lead to better resource allocation and higher transaction success rates [6]. Some studies also investigate hybrid models that combine recommendation engines with auctions, showing that personalization can significantly improve user engagement and overall system efficiency [7].

Despite these advancements, existing systems still face challenges, including:
Limited scalability for large user bases. Lack of real- time recommendation updates. Absence of a unified framework combining collaborative filtering with intelligent auction mechanisms for peer-to-peer trading.

This paper addresses these gaps by proposing an intelligent auction platform that leverages collaborative filtering to provide personalized item suggestions while facilitating competitive bidding, thereby enhancing both user experience and market efficiency.

PROPOSED SYSTEM / METHODOLOGY

A. System Architecture



Frontend: Allows users to browse items, place bids, and receive personalized recommendations.

Node.JS: Manages bidding processes, enforces auction rules, and calculates the winning bids.

Flask: Implements a collaborative filtering algorithm to predict user preferences and suggest relevant items.

Database: Stores user profiles, item information, historical transactions, and auction results.

B. Collaborative Filtering Approach

Collaborative filtering predicts a user's interest in items based on historical interactions and preferences of similar users. The platform uses a user-based CF approach, where similarity between users is computed using cosine similarity [4]:

$$\text{Sim}(u,v) = \frac{\sum r_{\in Iui}\, r_{u,i} \times r''_{v,i}}{\sqrt{\sum_{I \in Iui} r_{u,i}^{2}} \times \sqrt{\sum_{I \in Iu} r_{v,i}^{2}}}$$

C. Auction Mechanism

The platform implements a sealed-bid auction for each listed item:

Each bidder submits a confidential bid. The highest bid wins the item. Transactions are processed securely. This ensures fair market pricing, reduces manipulation, and improves user experience.

D. Workflow / Use Case

Users register and create profiles. Items are listed for auction . Recommendation Engine generates personalized suggestions. Users place bids on recommended items. Auction Engine determines winners and updates the database. Feedback from transactions is used to improve future recommendations.

IMPLEMENTATION AND RESULTS

A. Tools and Technologies

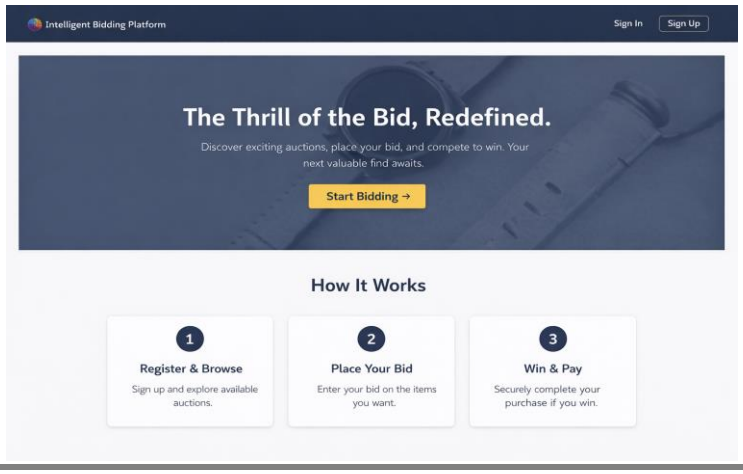
MERN Stack (MongoDB, Express.js, React.js, Node.js) for website development. Python (Scikit- learn, Pandas) for the collaborative filtering model.MongoDB for data storage . Cloud deployment for hosting the application.

B. Experimental Setup

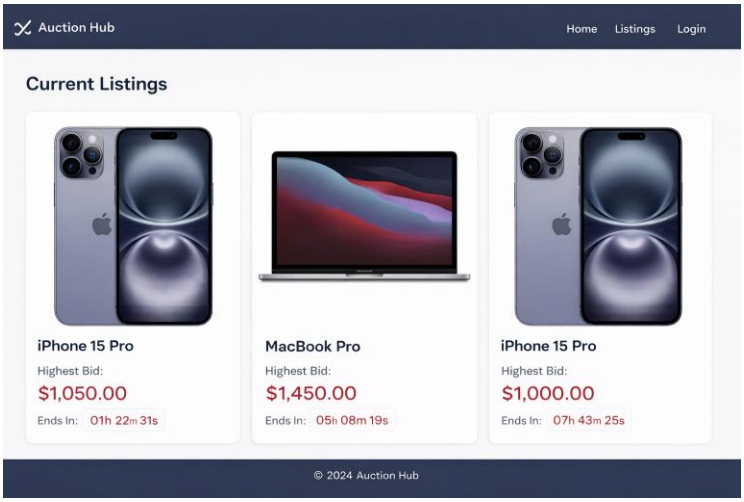
500 users, 1000 items (textbooks, electronics, furniture).Historical interactions generated to simulate realistic behavior.Evaluation Metrics: Transaction success rate, search efficiency, recommendation MAE, user satisfaction.

RESULTS

Home Page

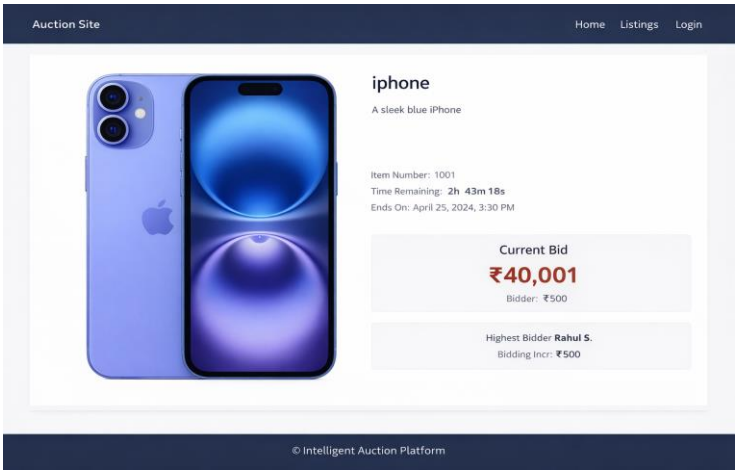


Listing page: here students will be able to see the listed Auctions items , and be able to participate in the auction that they want .



Auction Page of particular item:

Here Students can bid the items and at the end of the auction the winner will be declared with the highest bid.



DISCUSSION

Personalized recommendations reduce search time.Auctions ensure competitive pricing.MERN + Python deployment supports scalability.

Limitations: Simulated dataset; real-world deployment may require fraud detection and performance optimization.

CONCLUSION AND FUTURE WORK

This paper presents an Intelligent Recommendation- Driven Auction Platform that improves peer-to-peer trading efficiency using collaborative filtering and auction mechanisms. Experimental evaluation shows higher transaction success rates, lower search times, and increased user satisfaction.

FUTURE WORK

Deploy in real-world university/community settings. Integrate AI-based fraud detection. Explore hybrid recommendation methods. Optimize scalability for larger user bases.

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