Jashn Patel. 2026, 14:2
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Tradesphere : Multi-Dimensional Trust Platform

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Abstract – Due to the fast-paced emergence of online e-commerce platforms, the landscape of the virtual marketplace has been completely revolutionized by facilitating efficient communication between the buyers and sellers. However, the current systems suffer from a number of trust-related issues such as fake reviews, bias in product ratings, lack of seller responsibility, and lack of means to assess buyer behavior. Rating systems employed in the literature are mainly concerned about the ratings provided by the customers, which leads to an incomplete and often times inaccurate assessment of transaction-based trust. In this research, a Multi-Dimensional Trust Based Rating System (MDTRS) is proposed, where product rating, seller reputation, and buyer credibility are taken into account together in order to form a complete rating mechanism. The proposed rating mechanism differentiates itself from other rating algorithms since it evaluates all the parties involved in the transaction system and hence ensures complete responsibility. In the proposed system, a trust score calculator is developed using dynamic weights according to the credibility of the input and interaction history between the user and the service provider. The implementation of the system is performed through a scalable full-stack architecture along with buyer, seller, and administrator interfaces.

Keywords - E-commerce, Trust Management, Reputation System, Buyer Credibility, Seller Reputation, Product Rating

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I. INTRODUCTION

The advent of advanced technology has revolutionized the world of business and resulted in highly scalable e-commerce platforms. The emergence of contemporary online shopping portals like Amazon, Flipkart, and eBay has made it easy for users to interact with each other irrespective of their geographical locations. These platforms process millions of transactions every day, offering convenient, diverse, and cost-effective shopping experiences. Despite their extensive adoption, however, there are several inherent problems associated with these systems that need to be addressed.

Existing e-commerce portals adopt a product-oriented approach and allow users to leave their reviews only once they make a purchase decision. Although this system offers some useful insights, it has several significant drawbacks. In many cases, reviews can be subjective, manipulated, or biased, resulting in inaccurate and misleading information. Additionally, contemporary e-commerce platforms lack a holistic evaluation framework to judge the entire community of users.

This lack of a comprehensive framework results in problems such as fraudulent reviews, deception in product presentation, manipulation of refund policies, and inconsistent levels of service quality. Consequently, buyers have trouble making informed decisions during transactions, and reputable vendors find it difficult to compete with rogue vendors.

A possible solution to this problem involves creating an e-commerce platform with multiple dimensions that incorporate a more comprehensive system of evaluating trustworthiness along with intelligence-based interactions with users. Unlike most other systems, which typically consider two dimensions – namely, vendor trustworthiness and consumer reputation – the system described in this paper would evaluate all parties involved in the transaction process.

Additionally, the system proposed herein incorporates an artificial intelligence-based feature that will facilitate more efficient user engagement through intelligent modification of interface elements. Specifically, the interface is capable of dynamically changing components of its structure using HTML and CSS codes to provide better customer interaction.

An additional feature included in this system design is trust aggregation, where weightage will be allotted to certain feedbacks depending on user credibility and past performance. This feature will help decrease negative impacts due to bad faith users. The proposed trust management system utilizes a modern and contemporary full-stack architecture for scalability, modularity, and data handling purposes.

The rest of the paper is structured in the following manner: Section II briefly surveys the literature for prior work done on trust and reputation models in e-commerce systems. Section III explains our proposed multi-dimensional model for evaluation and trust management. Section IV provides a brief introduction to our proposed trust management

system along with methodology used in its construction.

II. RELATED WORK

One of the key aspects studied extensively by scholars regarding e-commerce is trust and reputation management, which are essential tools in affecting consumer behavior. One of the earliest platforms using an elementary reputation system was eBay, which included a system where customers rated sellers based on the transaction. This model set the stage for further developments, but it had limitations in that it did not consider the issue of credibility and susceptibility to manipulation.

Amazon and Flipkart were among other platforms to improve upon this model by including features such as product reviews, rating scales, and purchase verification. Although these measures increased transparency to some degree, literature suggests that even such a system is not

immune to flaws, such as the problem of fake reviews, review bombing, and incentivized ratings. Scholars have pointed out the significance of the lack of credibility checks in reviewers.

Some academic publications have suggested enhanced reputation schemes to resolve these challenges. For example, multi-criteria ratings try to assess various aspects of product and services, whereas a simple scoring model is used to estimate only one aspect. In addition, trust-based systems employ interaction and behavioral analyses to measure trustfulness and allocate credibility scores accordingly. These systems try to minimize the influence of bad guys by giving preference to reliable user feedback. Unfortunately, many of the proposed reputation schemes remain too complicated or do not offer any practical solutions at all.

A completely different problem concerns fraud detection and anomaly detection in e-commerce systems. This research field employs machine learning algorithms to detect fraudulent activities, including fake review writing, collusion, and other types of behavior. Although some interesting studies in this area have been published, the problem remains partially unresolved because most of these solutions need massive datasets and cannot be incorporated into existing trust systems.

On the other hand, modern web applications have been designed using the full-stack framework which includes Node.js, Express.js, Angular, and React. They have been designed in a manner that can help in creating dynamic and modular platforms where both front-end and back-end can be created to ensure efficiency. Recently, web applications have started integrating AI components in their design to create personalized services and interactions.

Despite these developments, the solution that has been used for solving problems related to trust, usability, and intelligence is independent in nature. There is no system available that can take into account multi-dimensional aspects of trust assessment along with usability and interaction abilities of users.

This paper presents the development of an integrated system that integrates the multi-dimensional trust evaluation model with the interactive interface using AI and the full-stack framework. Contrary to previous solutions, it takes into consideration all participants (users, products, and service providers).

III. METHODOLOGY

The proposed model is an interactive e-commerce system that uses multidimensional trust along with an artificial intelligence-supported interface. The model seeks to foster trust, increase system reliability, and provide for interactive user communication using a scalable full-stack approach. The methodology incorporates architecture design, trust modeling, algorithm development, AI implementation, workflow management, and data handling.

A. System Architecture

The architecture used in the system is three-tiered and consists of the presentation tier, application tier, and data tier.

The presentation tier is implemented in React, offering a responsive and interactive user interface. The application tier makes use of Node.js and Express.js for implementing the business logic, API routing, and authentication. The data tier utilizes MongoDB, an open-source NoSQL database management system.

B. Multi-Dimensional Trust Model

The framework used incorporates an assessment of trust by rating three components: product evaluation, which rates quality and satisfaction; seller evaluation, which assesses service and delivery; and buyer evaluation, which looks into behaviors such as review validation and return tendencies.

By adopting a multifaceted assessment, a more comprehensive and objective framework for determining trust is ensured.

C. Trust Score Aggregation Algorithm

The overall trust score is calculated using a weighted aggregation method:

$T=wpP+wsS+wbBT = w_p P + w_s S + w_b BT=wpP+wsS+wbB$

Each component is assigned a weight based on its importance. Additionally, a credibility-based mechanism is used, where ratings from trustworthy users have higher influence, while suspicious inputs are minimiz

D. AI-Assisted Interaction Module

An AI-powered module enhances user interaction by enabling real-time extraction and rendering of UI components such as HTML and CSS. Users can preview and modify components before final rendering, and the system can suggest improvements.

This feature transforms the platform into an **interactive and adaptive environment**, improving user engagement.

E. System Workflow

The system starts with user registration and authentication. Sellers upload items for sale, while buyers use AI-generated previews to browse through them. Once sales take place, users offer feedback from multiple angles, which helps in updating trust levels.

Such a feedback cycle ensures that the system is always evolving and improving.

F. Database Design and Security

The database contains users, products, orders, reviews, and trust scores in an organized format. Queries are performed efficiently to ensure quick results.

Data security is guaranteed using authentication, access controls, input validations, and secure API transactions.

G. Summary

The methodology integrates scalable architecture, multi-dimensional trust evaluation, and AI-assisted features to create a reliable, efficient, and interactive e-commerce

system.

IV. IMPLEMENTATION

The suggested solution can be built on a full stack MERN architecture, which guarantees scalability, modularity, and efficiency in handling data. The system will include frontend, backend, database, trust computation, and AI-assisted modules.

A. Frontend Implementation

The frontend will be implemented in React. It is designed as a set of reusable components, including homepage, product listings, authentication pages, and category views. Routing will ensure smooth navigation without reloading the whole page. State management will provide user sessions, authentication, and dynamic data like products and trust scores. A preview panel will render UI components (HTML/CSS) returned by the backend in real-time, enabling interaction with changes.

B. Backend Implementation

The implementation of the backend will be carried out in Node.js and Express.js, which will manage API management, business logic, and authentication. The process will be modular and involve routing, controllers, and models. RESTful APIs will allow performing operations like authentication, products, orders, and reviews.

C. Database Implementation

MongoDB will be utilized to implement the database in the suggested project. Collections will include users, products, orders, reviews, and trust scores.

Roles will be saved in user documents, listing details in product documents, and multi-dimensional ratings in review documents. References will ensure relationships between collections.

D. Trust Score Computation

The trust mechanism is implemented in the backend and updates dynamically after each transaction. The trust score is calculated using:

$$T = w_p P + w_s S + w_b BT = wpP + wsS + wbB$$

Scores are normalized, and user credibility is used to weight ratings, reducing the impact of fake inputs. To improve performance, trust scores are stored and updated incrementally instead of being recalculated each time.

E. AI-Assisted Interaction

An AI module enhances user interaction by retrieving HTML/CSS components from the database and rendering them dynamically on the frontend. Users can preview and modify components in real time, with AI suggesting improvements. This creates a more interactive and personalized experience.

F. API Design and Security

The system uses RESTful APIs with JSON data exchange for communication between frontend and backend. Proper

status codes and error handling ensure reliability.

Security is maintained through token-based authentication, encrypted passwords, input validation, and role-based access control, preventing unauthorized actions and misuse.

G. Performance and Scalability

Efficient performance is achieved through optimized queries and modularity. Often accessed items like trust levels are stored in cache. The scaleable architecture can handle an increase in users and future extensions such as recommendation engines.

H. Summary

The implementation integrates frontend, backend, and database components into a unified system that supports multi-dimensional trust evaluation and AI-assisted interaction, achieving high performance, scalability, and reliability.

V. RESULT AND EVALUATION

The proposed multi-dimensional trust-based e-commerce system was evaluated to measure improvements in trust reliability, system performance, and user experience.

A. Experimental Setup

The system was tested in a controlled environment using simulated buyers and sellers. Various scenarios, including genuine, biased, and malicious behaviors, were introduced to evaluate robustness. The platform was implemented using React, Node.js, Express.js, and MongoDB.

B. Trust Model Evaluation

The proposed model was compared with traditional single-rating systems. Unlike conventional approaches, it considers product quality, seller reputation, and buyer credibility, resulting in more balanced and reliable trust scores.

Malicious users had minimal influence due to credibility-based weighting. The trust score is computed as:

T=wpP+wsS+wbBT = w_p P + w_s S + w_b BT=wpP+wsS+wbB

The system effectively filtered abnormal ratings and maintained stable trust values.

C. Performance Analysis

The system demonstrated low response time and efficient data processing due to optimized backend logic and database queries. Incremental trust score updates reduced computational overhead, while the modular architecture supported multiple concurrent users without performance degradation.

D. AI Module Evaluation

Another way that the AI-assisted module benefited the software was through the ability of users to preview and edit UI elements in real time. It was possible for them to change various aspects of interfaces without reloading pages or manually configuring them. This approach made the experience of using the system even more user-friendly and efficient.

Moreover, intelligent suggestions provided by the system assisted users in adjusting UI elements and improving their qualities in accordance with pre-configured parameters. Thanks to the development of the AI-assisted module, the system transformed from a plain website browser to an interactive interface.

To conclude, the creation of the AI-assisted module positively affected the usability and interactivity of the website. The development of such features as real-time editing and intelligent suggestions resulted in increased user satisfaction and engagement.

E. Comparative Analysis

Compared to platforms like Amazon and Flipkart, the system provides:

- More reliable trust evaluation
- Reduced impact of fake reviews
- Better user engagement
- Improved transparency

F. Limitations and Summary

The system depends on sufficient historical data for accurate credibility assessment, and the AI module can be further improved.

Overall, the results show that the proposed system enhances trust reliability, user interaction, and performance, offering a significant improvement over traditional e-commerce platforms.

VI. PROJECT SCREENSHOTS

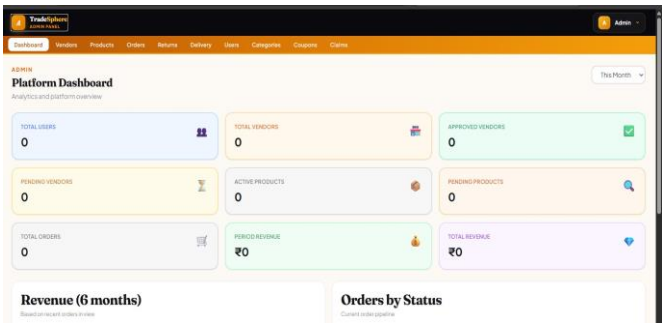

Figure A : Admin Dashboard of the Proposed E-Commerce Platform

Figure 9 above shows the design of the admin dashboard interface of the proposed multi-dimensional trust-based e-commerce system. The admin dashboard interface acts as a single point of control that offers real-time information on the state of the system.

The admin dashboard interface is shown in Figure 9 above, which contains important information such as total number of users, total number of vendors, number of approved vendors and number of pending vendors, number of active products and number of pending products, total number of orders, and revenue figures. The information helps the administrator monitor the state of the system and take actions.

The navigation panel comprises modules such as vendor management, product management, orders management, returns management, delivery management, user management, category management, coupon management, and claims management.

Besides, the system offers summarized financial information such as period revenue and total revenue figures. It also offers visual sections on the trend analysis and distribution of orders' status.

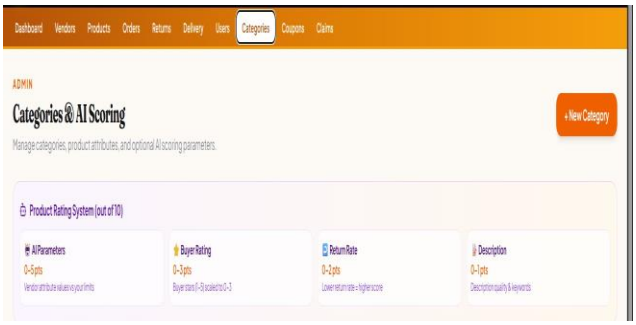

Figure B: Categories and AI-Based Scoring Interface

The following picture shows the module Categories and AI Scoring of the suggested e-commerce platform. Administrators can use it to create categories for their goods and services and set AI evaluation scores according to the established parameters in order to evaluate the products better.

The module provides a structured product rating system based on out of ten principle. The rating consists of several factors such as AI parameters, return rate, and product description quality. Every element in the product rating is weighted accordingly in order to balance the rating.

AI parameters represent a comparison between vendor information about attributes and system-defined limits, while buyer rating represents a user opinion about the product adjusted by a certain factor. Return rate is designed as a negative element of the rating because higher values are penalized.

Thus, the presented interface gives insight into how the suggested model integrates AI scoring with traditional methods to provide an enhanced product rating approach. Also, administrators can customize the parameters according to their needs.

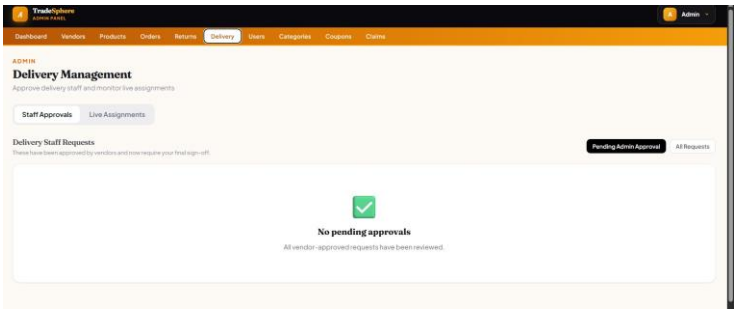

Figure C: Delivery Management Interface of the Proposed E-Commerce Platform

The illustration in Figure X above highlights the delivery management module of the proposed multidimensional trust-based e-commerce platform. This is the interface that acts as the central control point where administrative activities involving delivery staff are conducted, including live tracking of deliveries within the platform.The delivery management interface allows for the approval of vendor-delivery staff requests through its various components, such as staff approvals and live assignments.

From the image, it is clear that all delivery staff requests are either pending, accepted, or declined. In this case, the request is at the pending approval stage, implying that all vendor-approved requests have been handled by the administrator. This gives the administrator a real-time perspective on the number of pending requests and activities in the system

VI. CONCLUSION

This research proposes a multidimensional trust-based e-commerce system that attempts to overcome some fundamental problems associated with the traditional model, especially in terms of trust, transparency, and interaction. By transcending the boundaries of the existing rating mechanisms, the proposed system evaluates not only products themselves but also their sellers and buyers to ensure comprehensive analysis and decision-making.

By including a credibility-weighted rating scheme, the system allows credible users to have more influence on the system's operation and minimize the risk of manipulating the results. Moreover, the development of an AI-powered interaction component increases user interaction by allowing them to modify different UI elements to better suit their needs.

In terms of architecture, the system is developed in a scalable full-stack application architecture using React, Node.js, Express.js, and MongoDB. The experimental results indicate that the proposed system significantly improves trust accuracy and reduces manipulation while maintaining stable performance.

In conclusion, the system can be considered a solid, scalable, and intelligent tool for modern e-commerce platforms. Not only does it facilitate effective decision-making for users, but it also helps improve the platform's integrity and transparency.

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