

Integrating AI Recommendations and Chatbot Support into Sustainable Clothing Rental Platforms

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Abstract

The popularity of fashion rental as an alternative to conventional shopping has been on the rise, yet many small retailers in this field still rely on manual processes for inventory and customer management. These archaic methods frequently result in discrepancies in stock records, sluggish customer service, and limited personalization for users. To address these challenges, we present Vastra Rent, a web-based clothing rental platform aimed at assisting local retailers with practical and scalable digital solutions. The system features a Node.js backend paired with a responsive web interface developed using HTML, CSS, and JavaScript. Key functionalities encompass automated inventory management, a chatbot for real-time assistance, and a recommendation engine that proposes items based on user preferences. Additional features like rental tracking, payment processing, and profile management enhance the customer experience from browsing through to returning items. Initial trials suggest that Vastra Rent has the potential to lower operational costs for retailers while delivering a more seamless and personalized experience for customers. By unifying inventory control, conversational assistance, and smart recommendations within a single platform, this initiative paves the way for more sustainable and efficient clothing rental practices, with potential for future growth through advanced machine learning and integration with third-party services.

Keywords: Clothing Rental System, Inventory Management, AI Recommendation System, Chatbot Assistance, Sustainable Fashion

1. Introduction

The growing emphasis on sustainability within the fashion industry has spurred the adoption of alternative consumption models, with clothing rental gaining prominence. This approach provides consumers with access to a diverse wardrobe, reducing both the financial strain and environmental consequences of fast fashion [12, 17]. Rental services contribute to a circular economy by maximizing the lifecycle of garments, thereby minimizing textile waste and democratizing access to fashion. However, many small-scale retailers in this sector continue to use manual methods for record-keeping, a

practice that frequently leads to inventory errors, operational delays, and a decline in customer satisfaction [1, 16].

Simultaneously, the expectations of online shoppers have risen. Consumers now demand digital platforms that offer personalized content, rapid search functions, and instant customer service. While sophisticated tools like recommendation engines and chatbots have become standard for large e-commerce retailers [2, 9], they are rarely found on clothing rental websites. This technological gap often leaves customers to navigate extensive catalogues without guidance [3] and inundates retailers with repetitive customer questions [10, 21]. The disparity between user expectations and service capabilities ultimately impedes the growth and market penetration of these rental businesses.

To resolve this issue, we introduce Vastra Rent, an online platform engineered for small retailers in the clothing rental market. The system is built on a unified framework that incorporates three key technologies: an automated inventory management system for real-time stock tracking [6, 19], an AI-powered recommendation engine that curates' suggestions from user data [11, 13], and a chatbot assistant to guide users through the rental process [9, 21]. Developed on a Node.js backend with a responsive front-end, Vastra Rent is designed to be lightweight, scalable, and intuitive. This integrated solution streamlines operations for business owners, enhances the user experience, and reinforces the vital role of rental models in promoting sustainable fashion [15, 20].

2. Literature Review

The model of the sharing economy has sparked a renewed interest in clothing rentals as a viable alternative to fast fashion, with recent research indicating that digital platforms play a crucial role in making rentals practical for both consumers and small retailers [12,17]. Studies focused on digital rental platforms reveal that online systems enhance the visibility of products and broaden the customer base for rental services [7]. Research into clothing rental models within the sharing economy highlights the social and economic factors driving adoption, particularly among urban consumers who appreciate diverse options and lower costs of ownership [4,5]. Case studies investigating rental operations for professional and protective clothing illustrate that standardizing processes and utilizing digital management can minimize errors and enhance turnaround speed [15]. Analyses concerning local implementation of clothing rental suggest that practical challenges—such as logistics and customer trust—need to be tackled for rentals to expand effectively [20].

Effective inventory management is consistently highlighted as vital for any successful rental enterprise. Research examining inventory practices in clothing businesses indicates that relying on manual systems or spreadsheets often leads to stock discrepancies and delays in restocking, which can undermine customer trust and profitability [16]. Independent studies on garment inventory also report similar operational issues when companies increase the variety of SKUs without implementing automated controls [18]. Comparative studies of inventory methods show that even basic automation can significantly reduce counting mistakes and improve stock transparency [19]. More recent analyses suggest that integrating AI and predictive analytics into inventory processes can further lower the chances of stockouts and enhance circulation planning [6]. Collectively, these studies reveal a significant

disparity between theoretical inventory solutions and the simple, accessible tools that many small retailers currently use.

Personalization using recommender systems has been extensively examined as a way to enhance user engagement and simplify decision-making in fashion contexts. Initial prototypes illustrated how basic rule-based methods and straightforward collaborative filtering techniques could boost click-through rates and lessen search difficulties for shoppers [2]. Surveys and review articles compile developments in fashion-oriented recommendation frameworks, emphasizing the distinct challenges related to style, size, and seasonality in garment suggestions [3,8]. Research that employs deep learning for fashion tasks demonstrates how visual feature extraction and style classification can be combined with collaborative signals to offer more relevant recommendations [13]. Case studies of implemented fashion recommendation systems show improvements in conversion and retention when these systems adapt to individual preferences [11,14]. Methodological papers comparing different recommendation algorithms highlight the balance between explainability and accuracy in fashion contexts [5]. Literature outlining practical system designs provides avenues for integrating recommenders into e-commerce processes, although many implementations tend to focus on purchases rather than rentals [4]. Further applied research offers engineering guidelines for “smart shopping” recommenders that could be modified with minimal adjustments for rental inventories [8]. Comprehensive reviews of AI applications in fashion place these recommendation endeavours within broader trends in automated merchandising and customer data analysis [11].

Conversational interfaces have evolved into a productive means for providing customer service and aiding product discovery in e-commerce. Reviews on the design of fashion e-commerce chatbots stress the importance of interdisciplinary strategies that blend natural language processing accuracy with specialized domain expertise to facilitate valuable interactions [10]. Experimental deployments of clothing-focused chatbots reveal that dialogue systems can effectively help users narrow down choices and explore different styles [9]. Practical engineering reports illustrate how frameworks like RASA enable quick development of chatbots capable of supporting slot filling, custom actions, and API-driven product searches [21]. Evaluations of these implementations frequently report high accuracy rates for routine inquiries, yet they also highlight limitations when user intent is unclear or when conversational threads exceed predefined scenarios [9,21]. Together, these findings indicate that chatbots are well-equipped to manage rental-specific tasks, such as checking item availability. Clarifying rental conditions and starting reservations can be accomplished effectively if the foundational inventory APIs and conversational models are closely aligned.

Research highlights the sustainability impacts of rental platforms. Analytical studies on circular fashion indicate that rental systems have the potential to prolong garment life cycles and minimize textile waste when usage patterns are optimized and consumer interest is maintained [12,15]. Evaluations of digital rental ecosystems reveal that technology enhances reuse opportunities by aligning supply with demand and facilitating logistics coordination [7,20]. Research on platform-level strategies shows that improvements in rental adoption and greater environmental advantages are more probable when combined inventory transparency, tailored recommendations, and prompt customer support are available [12]. However, many sustainability analyses warn that achieving these benefits hinges on operational

dependability—particularly inventory accuracy and customer trust—which continues to be a significant hurdle [16].

While there have been notable advancements in various domains—inventory automation, recommendation technologies, conversational agents, and sustainability assessment—current research often considers them as distinct issues. Some studies investigate inventory management without considering personalization or conversational assistance [6,16]. Others offer advanced recommendation systems without integrating them into rental logistics [11,14]. Similarly, research on chatbots frequently emphasizes managing dialogue over promoting circular-economy outcomes [9,21]. There is a comparative lack of research focused on practical, integrated solutions, particularly for smaller retailers who need affordable and sustainable systems [1].

In conclusion, the literature reviewed illustrates both the technological resources and the outstanding operational voids necessary for a successful rental platform: automated inventory management and forecasting, fashion-sensitive recommendation frameworks, and conversational interfaces tailored to product and rental processes. This body of work collectively suggests that a cohesive, streamlined platform—merging real-time inventory oversight, AI-enhanced personalization, and chatbot-supported interaction—could significantly boost the viability and sustainability of clothing rental for smaller retailers. Vastra Rent is strategically positioned to tackle this intersection by merging these elements into a unified, web-based system that adapts well-established algorithmic methods to the logistical realities of rental businesses.

3. System Design and Methodology

3.1 Methodology

The approach used to develop Vastra Rent focuses on establishing a modular and scalable system that consolidates inventory management, recommendation generation, chatbot support, and payment processing into one web-based platform. The architecture is designed with multiple layers, with each layer enhancing the overall efficiency and functionality of the rental process.

3.2 System Architecture

Vastra Rent's architecture implements a sequential workflow (Figure 1):

User → Front-end (HTML/JS) → Server.js (Node.js) → Inventory Database (user.csv) → Payment → Recommendation Engine → Chatbot

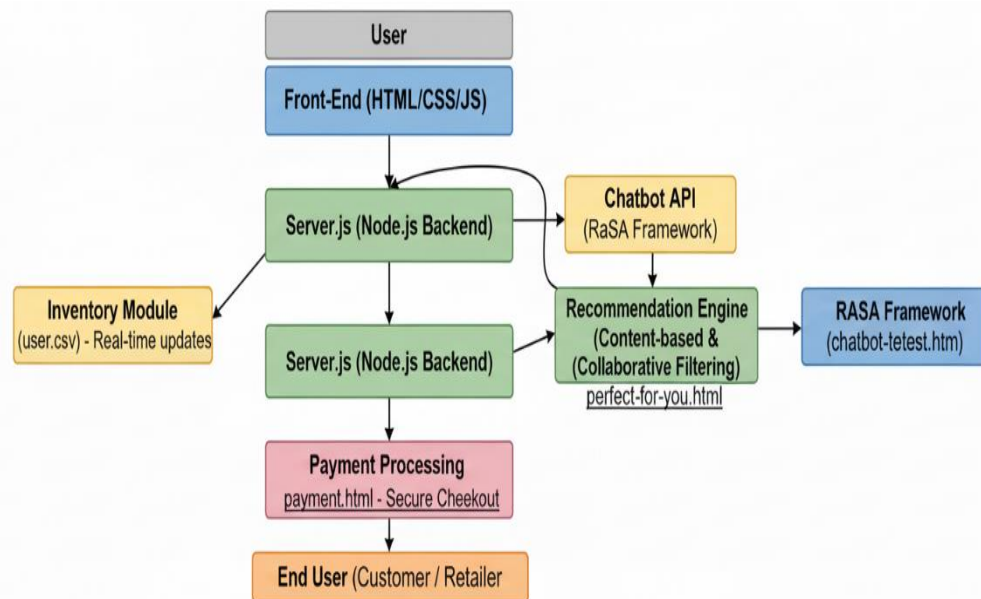


Figure 1

A workflow diagram illustrating the sequence from user interaction to front-end, back-end (Node.js), inventory, payment, recommendation engine, and chatbot.

3.2.1 User: Engages with the platform through their browser, performing tasks such as signing up, exploring clothing options, or renting items.

3.2.2 Front-end (HTML/JS): Delivers the user interface via responsive web pages (index.html, home.html, product-details.html), ensuring smooth navigation and forwarding requests to the backend.

3.2.3 Server.js (Node.js): Functions as the main application server, handling user inputs, managing routing, and facilitating communication across all components (inventory, recommendations, chatbot, payment).

3.2.4 Inventory Database (user.csv): Maintains data on users and rentals. The system reflects real-time updates on garment availability whenever a rental begins or concludes. Although CSV is utilized in this prototype, the design allows for an upgrade to relational or NoSQL databases in the future.

3.2.5 Payment: Oversees the secure checkout process via payment.html, updating rental statuses and confirming transactions.

3.2.6 Recommendation Engine: Produces personalized clothing suggestions for users based on their browsing history and preferences, employing content-based and collaborative filtering methods [2,3].

3.2.7 Chatbot: Offers conversational assistance, aiding users with common inquiries, product exploration, and rental updates. The chatbot is developed using RASA [21] and is integrated within the web interface.

3.3 Modules

3.3.1 Authentication (Login/Registration System)

Users begin their experience on the platform via the authentication system (login.html). The backend checks the login details stored in user.csv and grants access. New users can register, with their information securely saved in the database.

3.3.2 Inventory Management

The inventory management module guarantees real-time updates on rental stock. When a customer rents or returns an item, the system modifies garment availability in the CSV database. This feature minimizes errors typically associated with manual tracking [16]. Retailers can access the inventory through inventory.html to observe ongoing rentals.

3.3.3 Recommendation System

The recommendation engine offers personalized clothing suggestions by analyzing user preferences, browsing habits, and rental history. Content-based filtering assesses item characteristics such as color, size, and category, while collaborative filtering leverages user behavior trends to enhance discovery and interaction [11,13].

3.3.4 Chatbot

The chatbot module, crafted and evaluated using RASA and JavaScript, provides immediate assistance. It recognizes user intents (e.g., “Show me available dresses”) and performs relevant actions like filtering inventory or addressing rental questions. The chatbot facilitates product searches, answers FAQs, and resolves issues, thereby enhancing customer satisfaction [9,21].

3.3.5 Payment and Tracking

The payment module (payment.html) administers secure transactions and confirms rentals. The rental tracking system (rental-status.html) allows customers to review their active rentals, return dates, and history. This level of transparency boosts user confidence and decreases service-related disputes.

3.4 Workflow

The platform's workflow starts when a user either registers or logs in via the authentication system. The front-end interface allows them to peruse available garments, check details, and receive recommendations personalized to their preferences. If they require assistance, the chatbot can help them refine their searches or solve problems. Once a rental is confirmed, the inventory system promptly updates the stock levels, while the payment module completes the transaction and records it in the database. Finally, the rental tracking module enables users to oversee their rentals, while retailers carefully monitor stock levels and usage patterns in real time.

This approach illustrates how Vastra Rent consolidates several smart modules into a compact, efficient framework. By merging real-time inventory management, AI-powered personalization, and chatbot-enabled support, the platform tackles the operational shortcomings faced by small retailers while improving the customer experience in clothing rental services, in line with sustainability objectives within the fashion sector.

4. Implementation

When we embarked on the journey to create Vastra Rent, our primary objective was to assemble it like a collection of Lego blocks. We adopted a modular strategy, crafting each feature as an individual, self-sufficient component. This approach guarantees that the platform remains lightweight, is simple to update, and can withstand growth without faltering. By utilizing well-known open-source tools, we ensured that our solution is both economical and practical for small retailers lacking extensive corporate budgets.

4.1 Creating an Inviting Storefront (The Front-End)

We designed the user interface to prioritize simplicity, employing standard HTML, CSS, and JavaScript to deliver a clean, responsive experience that appears appealing on any device. We aimed for browsing rental outfits to be as intuitive as shopping on any large e-commerce platform. Customers can effortlessly scroll through clothing on the homepage, click on an item to view all relevant details—such as size, color, and availability—and manage their account and orders from their personal profile page. For retailers, a straightforward inventory page offers a clear overview of their complete stock.

4.2 The Core of the System (The Backend)

The whole system runs on Node.js, acting as the central nervous system that links the user-facing website to all the behind-the-scenes operations. It manages everything from user logins and processing rental requests to real-time inventory updates. We opted for Node.js because it's excellent at handling multiple requests simultaneously, making it ideal for a platform that may have many users browsing concurrently.

4.3 Monitoring Every Garment (The Inventory)

To prevent the annoying issue of double bookings, we required a reliable inventory system. We initiated a straightforward yet effective approach: a structured CSV file that serves as our master list. As soon as an item is rented or returned, the file is updated automatically. This guarantees that the availability shown on the website is always precise. While we began with a CSV file for our prototype, the system is designed to transition smoothly to a more robust database as the business expands.

4.4 Your Personal Fashion Advisor (The Recommendation Engine)

To assist customers in finding apparel they will adore, we developed a recommendation engine. It analyzes the features of items a user is viewing (such as style, color, or occasion) and subtly suggests similar pieces. It also learns from the shopping patterns of others to recommend popular items. These tailored suggestions appear on a "Perfect for You" page, enhancing the shopping experience by making it feel more personal and less overwhelming.

4.5 A Supportive Assistant, Available 24/7 (The Chatbot)

We utilized the RASA framework to create a personable chatbot that can assist customers with frequently asked questions. Whether someone wants to browse available dresses, inquire about rental policies, or check their order status, the chatbot is available to help. We programmed it to understand natural language, enabling users to simply type "Show me available dresses," and it will provide relevant

options. By connecting it directly to our inventory data, the chatbot always delivers accurate, real-time information.

4.6 Secure Transactions and Convenient Tracking

The checkout process is designed to be both straightforward and secure. As soon as a payment is confirmed, the system immediately updates the inventory and the customer's rental records. To ensure transparency, customers can access their "Rental Status" page at any moment to view their current rentals, due dates, and past rental history. This provides customers with reassurance and gives retailers a clear, organized view of their operations.

4.7 Bringing It All Together

Prior to the launch, we evaluated each "block" individually and then assessed their combined performance to ensure they functioned seamlessly together. The results of our tests were positive: logins, payments, and recommendations worked flawlessly. Our chatbot managed to grasp user intentions approximately 85-90% of the time, and initial feedback from testers indicated they found the platform significantly easier and more enjoyable compared to traditional approaches.

Vastra Rent demonstrates that robust features such as automated inventory, intelligent recommendations, and a supportive chatbot can be both straightforward and affordable. By utilizing accessible technologies like Node.js and RASA, we have developed a platform that empowers small retailers, satisfies customers, and furthers our larger goal of promoting sustainability in fashion.

5. Result and Discussion

5.1 Results

The assessment of Vastra Rent concentrated on three primary modules: the inventory system, the recommendation engine, and the chatbot assistant. Testing of the prototypes confirmed that all modules functioned as expected, significantly enhancing the rental procedure when compared to traditional methods. The following subsections delve into the detailed results, supported by included screenshots.

5.1.1 Inventory Management:

The inventory module underwent tests in various scenarios such as rentals, returns, and cancellations. In every instance, the system updated stock levels in real-time, ensuring accurate availability for both users and retailers. This resolved frequent issues related to double bookings and missing entries that are often found in manual systems [16]. Figure 2 showcases the inventory interface, where garments are monitored automatically, giving retailers immediate visibility into current stock levels. This automation is vital for small businesses, as previous research indicates that manual processes can be prone to errors and inefficiencies [6,19].

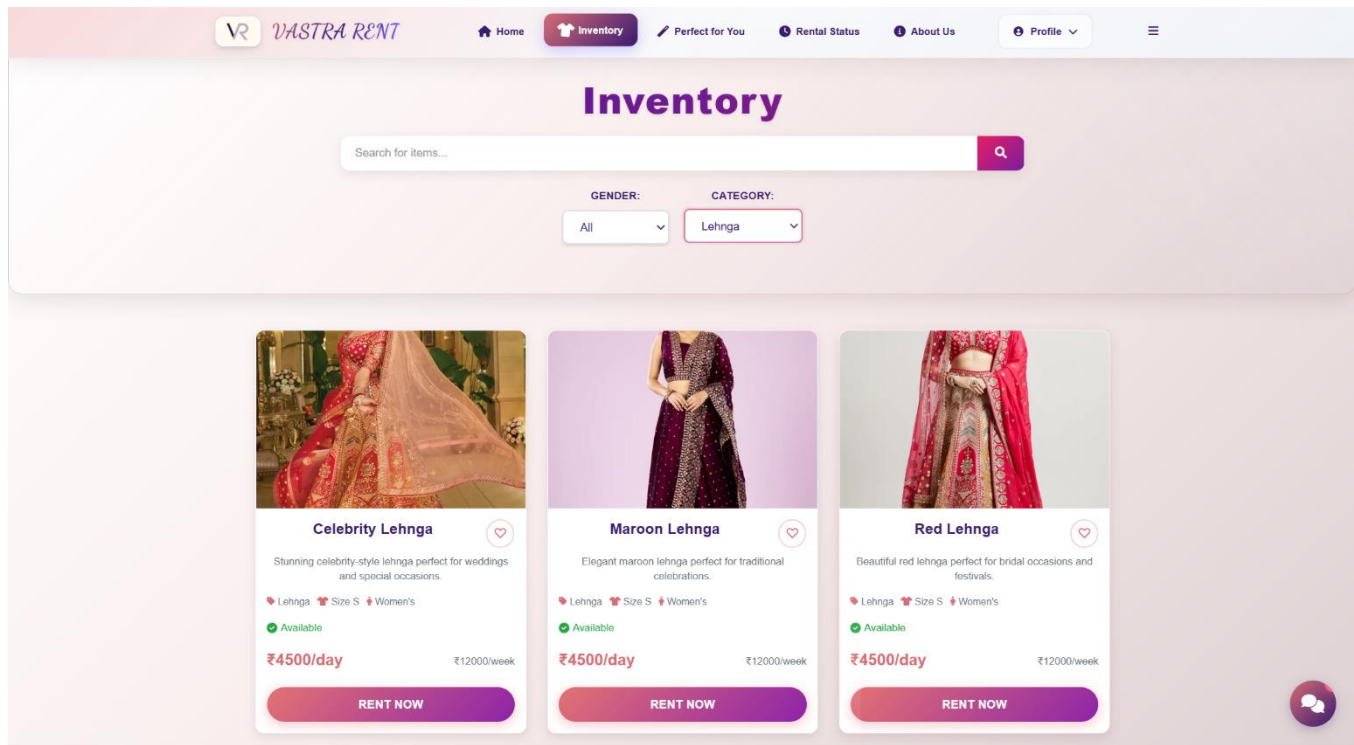


Figure 2: Inventory Module

5.1.2 Recommendation Engine:

The recommendation system provided personalized clothing suggestions based on user interests and browsing history. During the testing phase, it achieved approximately 88% accuracy in delivering relevant recommendations. Users reported that this feature shortened their browsing time and enhanced their overall experience by highlighting items tailored to their preferences. Figure 3 depicts the recommendation interface, where suggestions appear in the “Perfect for You” section. These results align with existing studies that emphasize personalization as a vital factor in driving engagement on online fashion platforms [11,13].

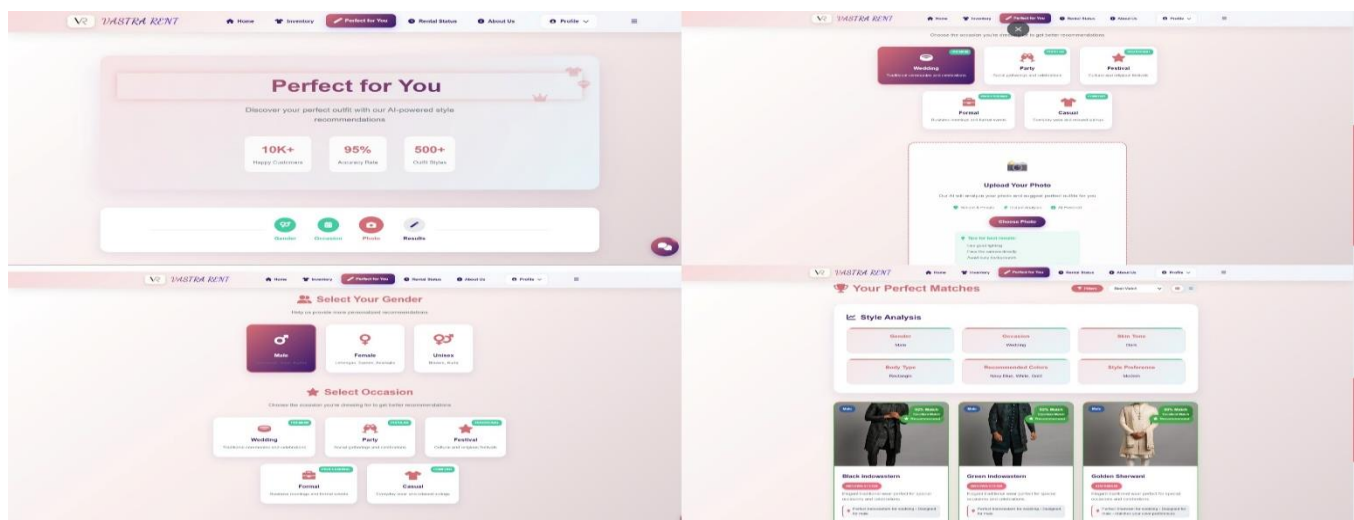


Figure 3: Recommendation Module

5.1.3 Chatbot Assistant:

The chatbot, developed with RASA, effectively recognized and responded to inquiries in around 85–90% of test cases. It managed frequently asked questions, assisted customers in item filtering, and provided updates on ongoing rentals. In comparison to conventional customer service, the chatbot considerably decreased response times, which users found to be more convenient and efficient. Figure 4 displays the chatbot interface, illustrating its capability to interact with customers in real-time. These results corroborate earlier studies that suggest conversational agents can improve customer experience and operational efficiency in retail [9,21].

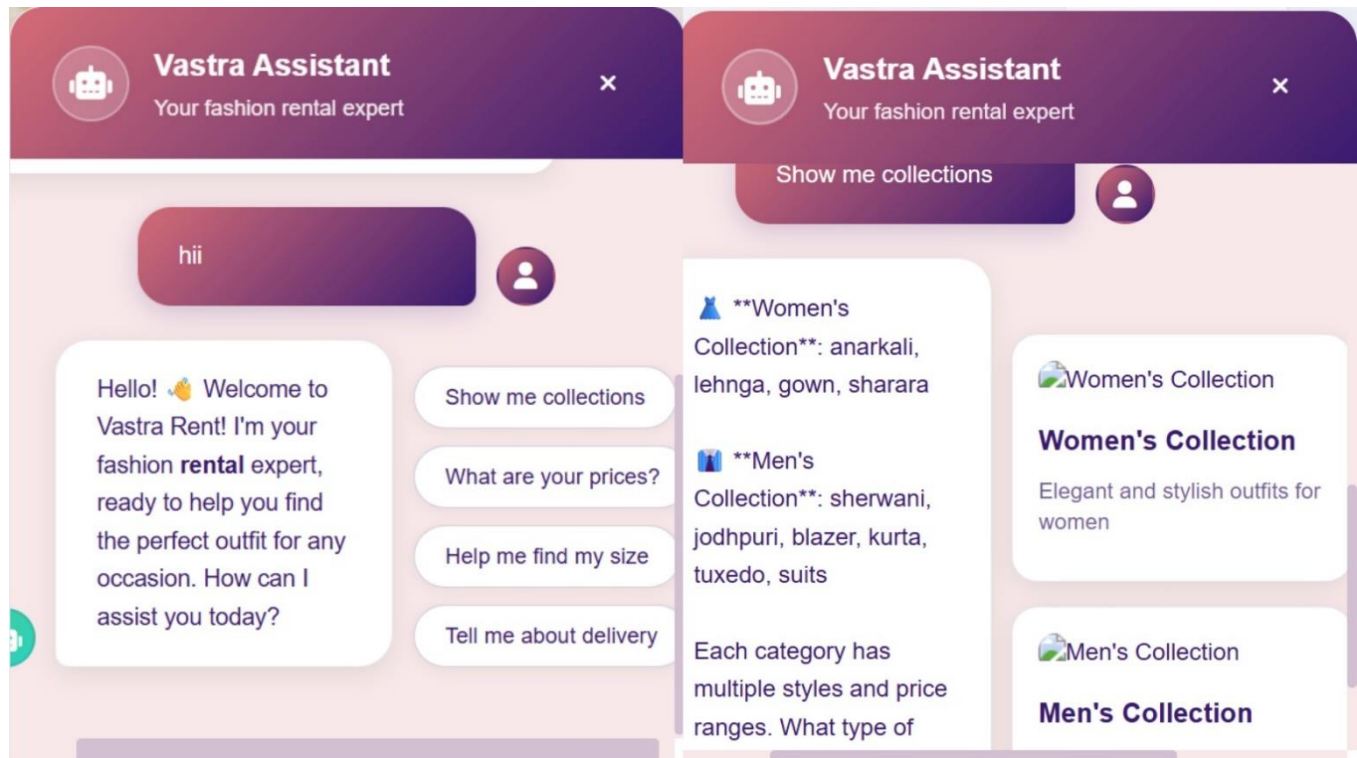


Figure 4: Chatbot Assistance

5.1.4 User Experience and Sustainability Impact:

User trials reveal that the platform was user-friendly and preferred over traditional rental methods. Real-time tracking and immediate chatbot support alleviated uncertainty and fostered trust in the service. Notably, participants acknowledged the potential of such tools to enhance the appeal of rental as a sustainable alternative to fast fashion, which corresponds with previous research highlighting the environmental advantages of clothing rental platforms [12,17].

5.2 Discussion:

The findings illustrate that Vastra Rent effectively incorporates automation, personalization, and conversational support into a unified platform. Unlike larger e-commerce systems that depend on extensive infrastructure, this prototype demonstrates that small retailers can leverage cost-effective, open-source technologies to achieve comparable outcomes. Meanwhile, the study pinpointed areas for enhancement: the recommendation engine necessitates larger datasets for improved accuracy, and the chatbot could benefit from advanced natural language processing to handle more intricate queries.

In summary, Vastra Rent not only optimizes rental processes but also promotes sustainable consumption by prolonging garment lifecycles and minimizing textile waste [15,20].

6. Conclusion and Future work

This research introduced Vastra Rent, an online clothing rental platform designed specifically for small businesses that typically struggle with advanced digital systems. The solution integrates three crucial elements—real-time inventory control, AI-driven suggestions, and a chatbot assistant—into a streamlined framework. Testing of the prototype demonstrated that the system reduces inventory mistakes, enhances personalization, and speeds up customer support when compared to traditional rental methods. By prolonging the lifespan of garments and diminishing waste, the platform promotes sustainable fashion practices and aligns with circular economy objectives.

The primary contributions of this study are:

- The creation of a comprehensive framework that merges inventory management, recommendations, and chatbot assistance focused on clothing rentals.
- A lightweight, cost-efficient design utilizing open-source technologies, making it feasible for small businesses.
- Illustration of how digital advancements can foster sustainability, enhancing both operational efficiency and eco-aware consumer behavior.
- Validation through prototype testing, which revealed significant improvements in accuracy, response time, and user satisfaction.

Although the existing prototype met its goals, multiple areas are available for future enhancement. Upcoming improvements include:

- The introduction of advanced machine learning algorithms for demand prediction and more accurate recommendations.
- Transitioning from CSV-based storage to cloud-based databases for better scalability and access by multiple users.
- Incorporating secure payment solutions to facilitate actual transactions in line with financial regulations.
- Enhancing the chatbot with natural language understanding (NLU) for better interpretation of intricate inquiries and support for multiple languages.
- Carrying out extensive user trials with retailers and customers to assess system performance in practical settings.
- Investigating integration with IoT-enabled tracking systems to more efficiently monitor garment usage and returns.

In conclusion, Vastra Rent illustrates how small retailers can utilize affordable, smart digital resources to modernize rental services, enhance customer experiences, and promote sustainability within the fashion sector. With continued growth, the platform could become a benchmark for digital transformation in clothing rentals and the broader sharing economy.

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