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Research Paper

GENAI-POWERED CHATBOT FOR E-COMMERCE CUSTOMER SUPPORT

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Abstract

The GENAI-Powered Chatbot for E-Commerce Customer Support is an intelligent web-based application designed to provide automated, real-time, and human-like customer support for online shopping platforms. The system is developed using HTML, CSS, and JavaScript for the frontend interface and powered by the Groq API integrated with the LLaMA 3.3 70B Large Language Model for advanced conversational intelligence. The primary objective of the chatbot is to assist customers by providing instant, accurate, and user-friendly responses to queries related to product information, order tracking, return policies, payment methods, pricing inquiries, and product recommendations for an e-commerce platform called ShopEasy.

The chatbot utilizes advanced Natural Language Processing (NLP) and Generative Artificial Intelligence technologies to understand customer inputs, analyze intent, and generate context-aware responses dynamically in real time. Unlike traditional rule-based chatbot systems that rely on predefined responses and limited workflows, the proposed system leverages Generative AI to handle a wide variety of customer queries flexibly and intelligently. The chatbot can provide personalized product suggestions, assist users with order-related information, explain return and refund policies, and guide customers through payment and delivery processes efficiently.

The application includes an interactive and user-friendly chat interface featuring quick-action buttons, typing indicators, conversation history, and responsive UI components to improve customer engagement and accessibility. The system provides 24/7 automated support without requiring constant human intervention, reducing customer waiting time and improving overall service quality. Real-time conversational capabilities allow customers to interact naturally with the chatbot, creating an experience similar to communicating with a human support agent.

I. Introduction

In today's rapidly growing digital marketplace, customers expect immediate, accurate, and personalized responses to their queries while shopping online. Modern e-commerce platforms handle thousands of customer interactions daily related to product information, order tracking, delivery status, return policies, payment methods, and refund processes. Traditional customer support systems mainly rely on human support agents, which often leads to longer response times, limited service availability, increased operational costs, and inconsistent customer experiences. As online

shopping continues to expand globally, there is a growing need for intelligent automated systems capable of providing fast, reliable, and efficient customer support services.

The advancement of Artificial Intelligence (AI) and Generative Artificial Intelligence (GenAI) technologies has significantly transformed the field of customer service and conversational systems. Modern AI-powered chatbots are capable of understanding user intent, processing natural language, and generating human-like responses dynamically in real time. Unlike traditional rule-based chatbot systems that depend on predefined commands and static responses, Generative AI chatbots use advanced Natural Language Processing (NLP) and Large Language Models (LLMs) to handle a wide range of customer queries flexibly and contextually. These intelligent systems improve user interaction by enabling natural conversations similar to communicating with human support representatives.

The GENAI-Powered Chatbot for E-Commerce Customer Support project is developed as an intelligent web-based customer support application designed for an e-commerce platform called ShopEasy. The system, named ShopBot, is implemented using HTML, CSS, and JavaScript for the frontend interface and powered by the Groq API integrated with the LLaMA 3.3 70B Large Language Model for advanced conversational intelligence. The chatbot is capable of assisting customers with various tasks such as order tracking, return and refund policies, product recommendations, payment guidance, pricing inquiries, and shipping information.

II. Literature Survey

The literature survey for the **GENAI-Powered Chatbot for E-Commerce Customer Support** focuses on the evolution of chatbot technologies, advancements in Generative Artificial Intelligence, and the growing adoption of AI-powered conversational systems across industries such as e-commerce, education, healthcare, and customer support. Over the years, chatbot systems have evolved from simple rule-based programs into advanced AI-driven conversational agents capable of understanding natural language and generating human-like responses dynamically.

Evolution of Chatbots and Generative AI

Early chatbot systems were primarily rule-based and operated using predefined commands, decision trees, and keyword matching techniques. These systems could only respond to limited and predictable user queries, making them inflexible and unable to handle complex conversations effectively. Traditional chatbots also lacked contextual understanding, personalization, and conversational continuity, which reduced user satisfaction and usability.

The advancement of Artificial Intelligence (AI) and Natural Language Processing (NLP) introduced machine learning-based conversational systems capable of understanding textual patterns and user intent more effectively. However, a major transformation occurred with the emergence of Generative AI (GenAI) and Large Language Models (LLMs) such as ChatGPT and LLaMA. These models use Transformer-based architectures and self-attention mechanisms to understand context, semantics, and conversational flow, enabling chatbots to generate fluent, intelligent,

and human-like responses dynamically. Research studies show a significant increase in publications and industrial adoption of GenAI technologies after 2022, highlighting their growing importance across multiple domains.

Applications of GenAI Chatbots

1. E-Commerce and Customer Support

One of the most important application areas of Generative AI chatbots is e-commerce customer support. Research studies demonstrate that AI-powered chatbots significantly improve customer service efficiency, reduce response time, and lower operational costs for businesses. In e-commerce environments, chatbots are widely used for:

- Product recommendations
- Order tracking
- Return and refund assistance
- Payment guidance
- Customer query resolution

AI-based support systems improve customer satisfaction by providing instant and personalized assistance without requiring continuous human intervention. Studies also show measurable reductions in customer waiting time and improved scalability in handling large numbers of customer interactions simultaneously.

2. Education Sector

Generative AI chatbots are increasingly used in educational environments to provide intelligent tutoring, personalized learning assistance, and automated student support. A recent literature review analyzing multiple studies found that AI chatbots improve:

- Student engagement
- Learning performance
- Critical thinking skills
- Self-directed learning capabilities

These systems provide instant feedback, personalized explanations, and continuous learning support, making them highly effective educational tools.

3. Healthcare and Mental Health

Research also highlights the growing adoption of AI-powered chatbots in healthcare and mental health support systems. Studies indicate that conversational AI systems help:

- Reduce anxiety and depression
- Provide emotional support
- Improve accessibility to healthcare services
- Offer preliminary symptom analysis and guidance

However, researchers also emphasize concerns related to reliability, ethical limitations, and the lack of human judgment in sensitive healthcare situations.

Advantages of GenAI Chatbots

The literature identifies several important advantages of Generative AI-based chatbot systems:

- Human-like interaction using NLP and Large Language Models
- 24/7 availability for continuous customer support
- Scalability to handle multiple users simultaneously
- Personalized responses based on user intent and context
- Reduced operational costs compared to human support agents
- Faster response generation and improved customer engagement
- Ability to understand natural conversational language dynamically

These benefits make GenAI chatbots highly suitable for modern digital platforms requiring automated and scalable customer interaction systems.

Challenges and Limitations

Despite their advantages, Generative AI chatbots still face several research and implementation challenges:

- Risk of generating incorrect or misleading responses
- Over-reliance on AI systems without human verification
- Ethical concerns and data privacy issues
- Lack of transparency in AI decision-making processes
- Dependency on APIs and stable internet connectivity
- Potential bias in generated responses
- Difficulty handling highly domain-specific or ambiguous queries

Researchers emphasize the importance of responsible AI usage, model monitoring, and secure data handling practices in chatbot systems.

Research Gap

The literature indicates that while Generative AI chatbots are widely implemented in domains such as education, healthcare, and general customer support, their application in lightweight, browser-based e-commerce customer support systems powered by modern Large Language Models such as **LLaMA 3.3** integrated through the **Groq API** remains relatively limited. Most existing solutions either rely on cloud-heavy infrastructures or lack domain-specific intelligence for e-commerce operations.

There is a growing need for:

- Domain-specific chatbot solutions for e-commerce
- Real-time product recommendation systems
- Intelligent order tracking and policy assistance
- Lightweight browser-based AI applications

- Accessible and cost-efficient web technologies for small businesses

The GENAI-Powered Chatbot for E-Commerce Customer Support project addresses these research gaps by integrating Generative AI, NLP, and modern web technologies into a scalable and intelligent customer support platform specifically designed for e-commerce environments.

III. System Analysis

The GENAI-Powered Chatbot for E-Commerce Customer Support system is designed to provide intelligent, automated, and real-time customer support services for online shopping platforms using Generative Artificial Intelligence and Natural Language Processing technologies. The system focuses on improving customer interaction by understanding user queries and generating human-like responses dynamically. It assists customers with tasks such as order tracking, return and refund policies, payment methods, product recommendations, pricing inquiries, and shipping information. The chatbot utilizes advanced Large Language Models such as LLaMA 3.3 integrated through the Groq API to perform contextual understanding and conversational response generation. Unlike traditional rule-based systems, the proposed chatbot can handle diverse customer conversations without relying on predefined answers. The application provides a responsive and interactive chat interface with features such as quick-action buttons, typing indicators, and conversation history. Real-time conversational capabilities improve customer satisfaction by reducing waiting time and ensuring continuous support availability. The system also supports scalable customer interaction management for handling multiple users simultaneously. The modular architecture allows future integration of multilingual support, voice interaction, sentiment analysis, and recommendation systems. Overall, the system provides a scalable, intelligent, and efficient AI-driven customer support solution for modern e-commerce platforms.

Existing System

In the existing system, e-commerce customer support mainly depends on human support agents and traditional rule-based chatbot systems. Human-based support systems often suffer from longer response times, limited working hours, increased operational costs, and inconsistent customer experiences. Traditional rule-based chatbots use predefined commands, keyword matching, and decision-tree logic to respond to user queries. Although these systems can handle basic and repetitive tasks, they lack contextual understanding and flexibility in conversations. Existing chatbot systems are limited to predefined responses and cannot dynamically understand complex customer queries or natural conversational language. Most traditional chatbots fail to provide personalized recommendations and struggle to handle unexpected or ambiguous questions. Existing systems also face scalability challenges when managing large numbers of simultaneous customer interactions during peak shopping periods. Many earlier customer support platforms lack real-time conversational intelligence and interactive user interfaces. Dependency on human intervention for complex queries further reduces efficiency and increases workload. These limitations create the need for intelligent Generative AI-powered customer support systems capable of understanding context and providing human-like assistance dynamically.

Disadvantages of Existing System

- Dependence on human customer support agents.
- Longer customer response and waiting times.
- Limited working hours and service availability.
- High operational and staffing costs.
- Rule-based systems lack contextual understanding.
- Inability to handle complex or unexpected queries.
- Limited personalization and recommendation capabilities.
- Poor scalability during high customer traffic.
- Static predefined responses reduce flexibility.
- Lower customer satisfaction and engagement.

Proposed System

The proposed GENAI-Powered Chatbot for E-Commerce Customer Support system is designed to provide intelligent, real-time, and human-like customer assistance using Generative Artificial Intelligence and Natural Language Processing technologies. The system utilizes the Groq API integrated with the LLaMA 3.3 70B Large Language Model to understand customer intent and generate context-aware conversational responses dynamically. The chatbot assists users with order tracking, return and refund policies, payment options, pricing inquiries, shipping details, and personalized product recommendations efficiently. Unlike traditional rule-based systems, the proposed chatbot can understand natural conversational language and respond flexibly to a wide range of customer queries without relying on predefined scripts. The application includes an interactive and responsive chat interface with quick-action buttons, typing indicators, and conversation history for improved user engagement. Real-time conversational processing enables instant customer support and continuous 24/7 availability without human intervention. The modular architecture supports future enhancements such as multilingual communication, voice interaction, recommendation systems, sentiment analysis, and integration with live order management systems. The proposed system reduces operational costs, improves customer satisfaction, and increases scalability for handling multiple customer interactions simultaneously. Overall, the system provides an intelligent, scalable, and AI-powered customer support solution for modern e-commerce platforms.

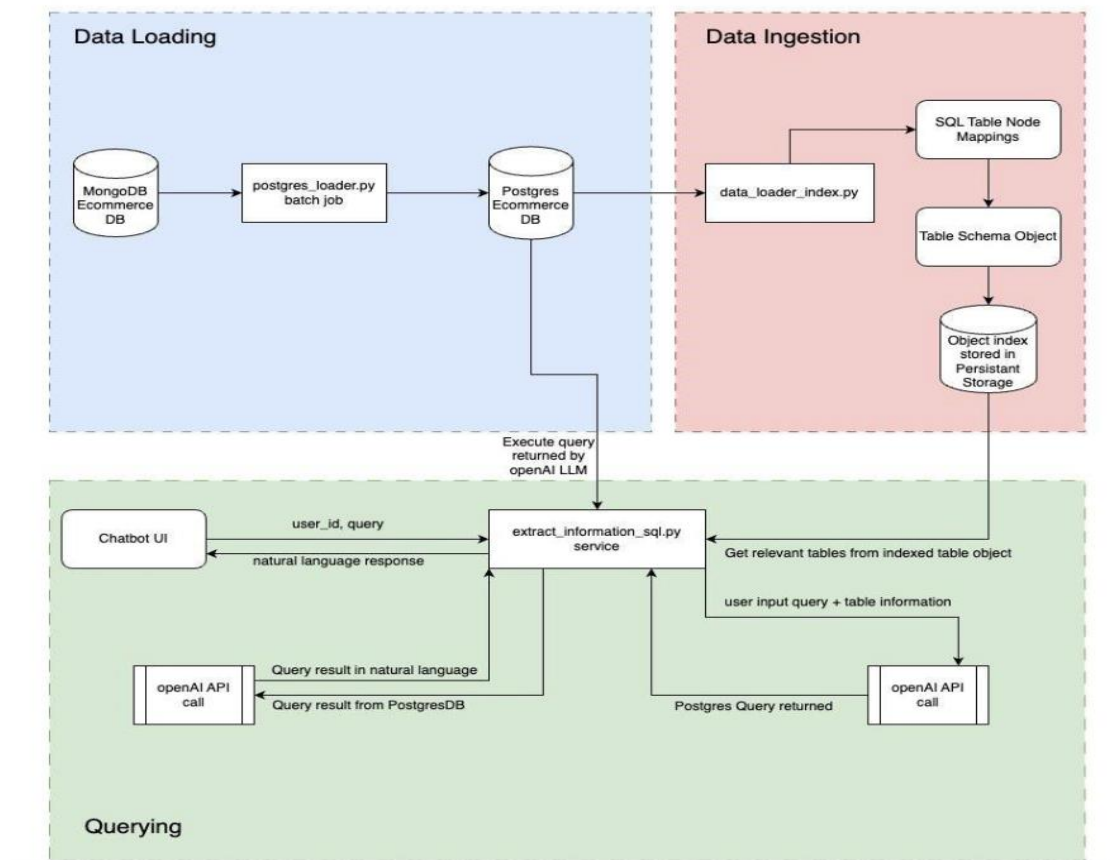
Advantages of Proposed System

- Provides instant and real-time customer support.
- Human-like conversational interaction using Generative AI.
- Supports 24/7 automated customer assistance.
- Reduces operational and staffing costs.
- Handles multiple customer queries simultaneously.
- Improved contextual understanding and response generation.
- Supports personalized product recommendations.
- Flexible handling of diverse customer queries.
- Interactive and user-friendly chat interface.
- Scalable for future AI and e-commerce integrations.

IV. Methodology

The development methodology of the GENAI-Powered Chatbot for E-Commerce Customer Support system includes requirement analysis, frontend development, AI integration, NLP processing, backend communication, testing, and deployment phases. Initially, customer support requirements and common e-commerce query categories such as order tracking, payment assistance, product recommendations, and return policies were identified and analyzed. The frontend user interface was developed using HTML, CSS, and JavaScript to create an interactive and responsive chat environment. Natural Language Processing techniques were integrated to preprocess user queries and improve conversational understanding. The Groq API and LLaMA 3.3 Large Language Model were connected to generate intelligent and context-aware responses dynamically. Backend communication modules handled API requests, response generation, conversation management, and real-time processing operations. Features such as quick-action buttons, typing indicators, and conversation history were implemented to enhance user experience and engagement. Testing was performed to evaluate response accuracy, conversational quality, system performance, and scalability under multiple user interactions. Optimization techniques improved response generation speed and interface responsiveness. Finally, the complete chatbot application was deployed as a web-based AI-powered customer support system for e-commerce platforms. The methodology ensures scalability, maintainability, efficient AI integration, and improved customer service automation.

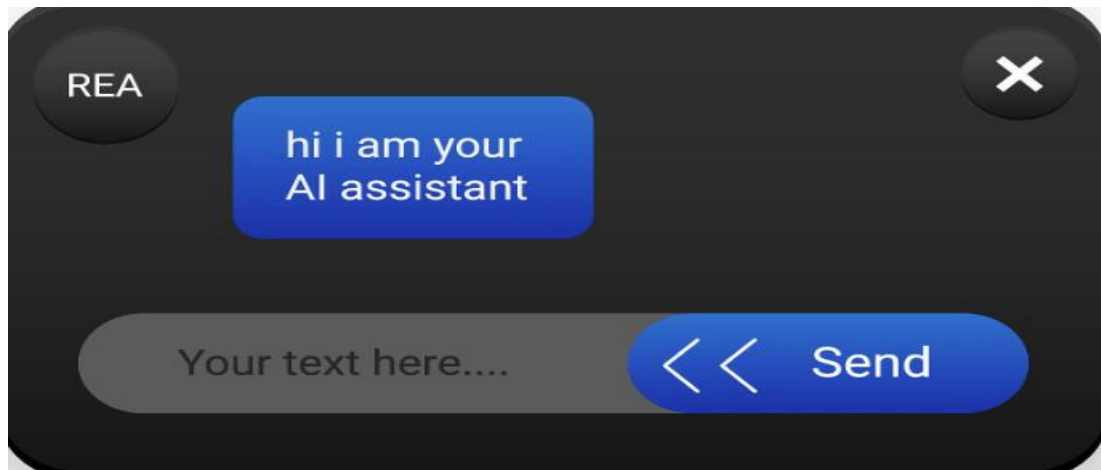
System Architecture

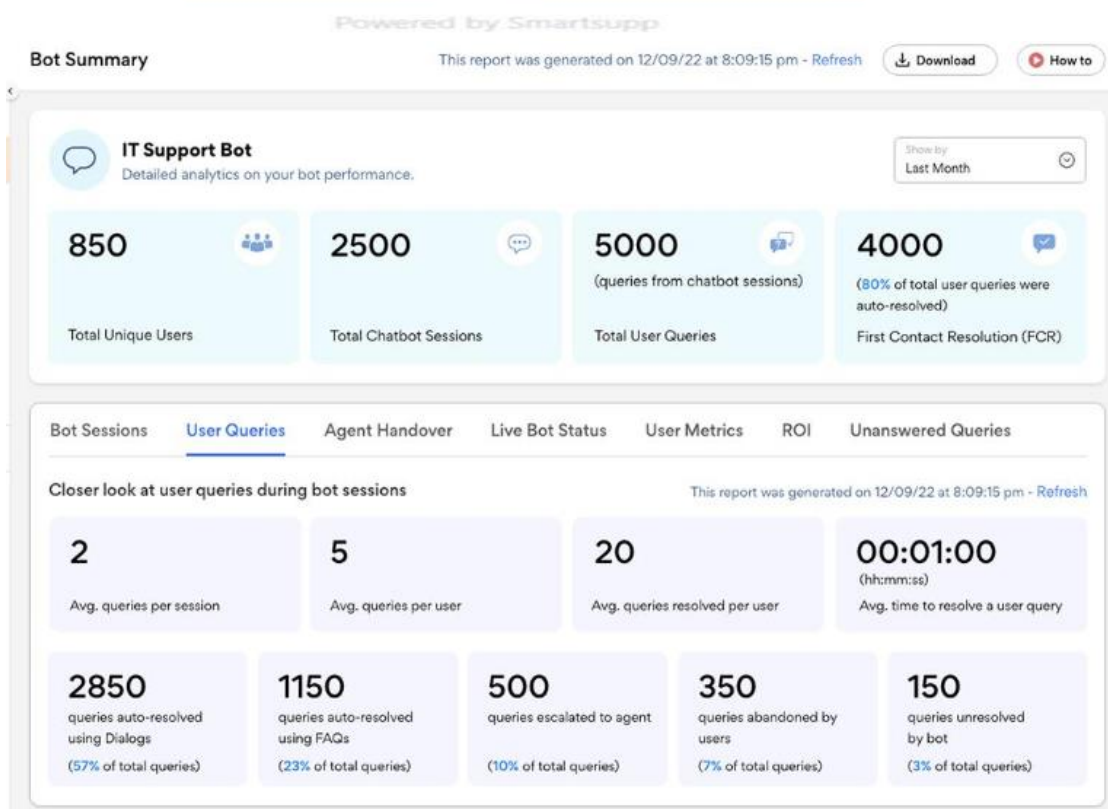
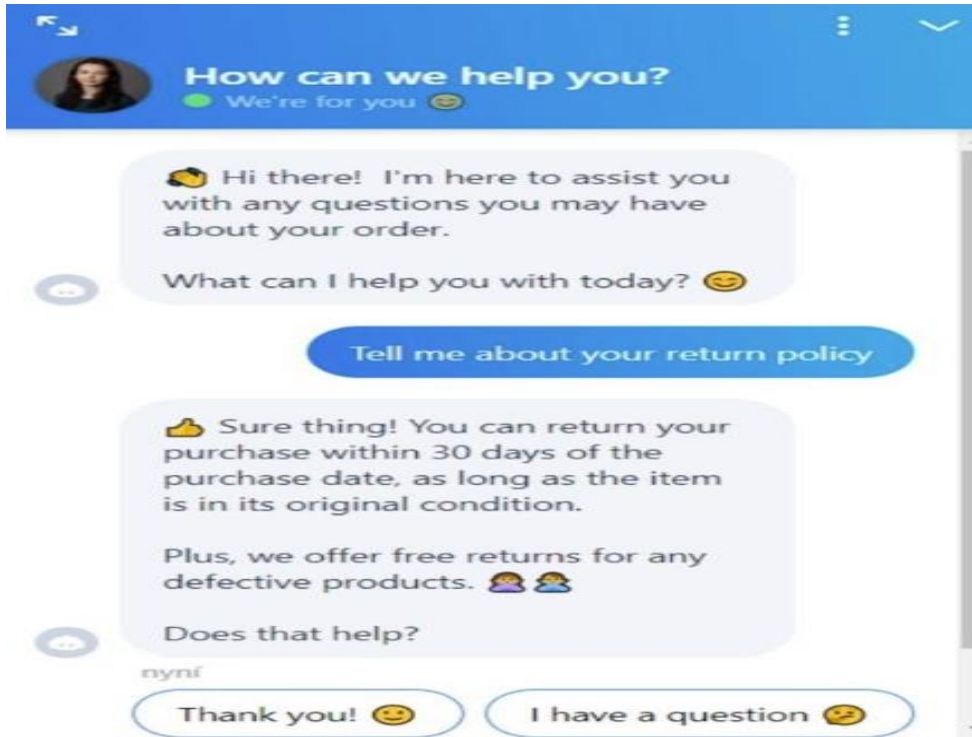


The system architecture of the GENAI-Powered Chatbot for E-Commerce Customer Support follows a layered architecture consisting of user interface, NLP processing,

AI model integration, backend communication, database, and API layers. The user interface layer provides an interactive chat environment where customers can enter queries related to products, orders, payments, and policies. The frontend is developed using HTML, CSS, and JavaScript with responsive design features such as typing indicators, quick-action buttons, and conversation history. The NLP processing layer analyzes customer input, performs tokenization, intent recognition, and contextual preprocessing to improve understanding of user queries. The AI integration layer connects the chatbot to the LLaMA 3.3 Large Language Model through the Groq API for dynamic response generation and conversational reasoning. The backend communication layer manages API requests, response handling, session management, and real-time interaction processing. The database layer stores customer conversation history, product details, frequently asked questions, and chatbot interaction logs securely for future analysis and personalization. Security modules ensure safe API communication and secure handling of customer information.

V. Result and Output





VI. Conclusion

The GENAI-Powered Chatbot for E-Commerce Customer Support project successfully demonstrates the practical application of Generative Artificial Intelligence and Natural Language Processing technologies in modern e-commerce customer service systems. By integrating advanced Large Language Models such as LLaMA 3.3 through the Groq API, the system provides intelligent, real-time, and

human-like conversational support for online shopping platforms. The chatbot effectively handles a wide range of customer queries including order tracking, return and refund policies, payment assistance, shipping information, pricing inquiries, and product recommendations. Unlike traditional rule-based chatbot systems, the proposed solution dynamically understands user intent and generates context-aware responses, significantly improving customer interaction quality and user satisfaction. The implementation of features such as quick-action buttons, typing indicators, conversation history, and responsive chat interfaces further enhances user engagement and accessibility.

The project demonstrates strong performance in terms of conversational accuracy, context retention, response generation speed, and scalability. By providing 24/7 automated customer assistance, the system reduces customer waiting time, lowers operational costs, and minimizes dependency on human support agents. The chatbot also supports efficient handling of multiple customer interactions simultaneously, making it highly suitable for modern high-traffic e-commerce environments. The integration of frontend web technologies with Generative AI models highlights the effectiveness of combining HTML, CSS, JavaScript, NLP techniques, and AI APIs to create intelligent browser-based applications. The modular system architecture also supports future enhancements such as multilingual communication, voice interaction, sentiment analysis, personalized recommendation systems, and integration with real-time inventory and order management platforms.

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