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AI-Powered E-Commerce Shopping Agent Using Agentic Tool Orchestration and Gemini LLM

Nikhil Mana[1], Onaiza Khan[2], Sri Tejas M C [3], Yashaswini A R[4], Ranjith K C[5]
[1,2,3]*Students,* [4]*Assistant Professor,* [5]*Associate Professor, Department of CSE–AIML, MIT Mysore, India*

***Abstract*— The current e-commerce is no longer a simple system of catalogue sites but a multifaceted ecosystem that needs individualized and efficient user experiences. Old platforms tend to use search by keywords which do not fulfil the modern user expectation, and this results in a failure to discover. In this study, a novel AI-powered E-Commerce Shopping Agent combining conventional retail processes with autonomous decision-making is presented. The system uses a FastAPI backend, structured SQLite database, and Google Gemini API to coordinate more than 48 specialty tools to accomplish complex shopping chores. Findings indicate that database-driven tools grounding Large Language Models (LLMs), and sensitise these systems can lead to greater reliability, as well as minimise generative hallucinations, in commercial contexts.**

***Keywords*—AI Shopping Agent, Autonomous Agents, Conversational AI, E-commerce, FastAPI, Gemini API.**

I. Introduction

The online shopping environment is moving towards the autonomous systems which ease the time taken in searching products. Traditional e-commerce systems usually rely on the human navigation and simplistic recommendation algorithms that usually lead to the inability to find the relevant objects in a huge catalogue. The proposed project presents a conversational AI agent aimed at supporting natural language communication, the process of comparing products, and automated purchasing operations. The system offers a comprehensive solution of individualized retail and greater accessibility by storing these capabilities in an interactive, animation-based interface.

II. Theoretical Framework

The design of the system is inspired by the fundamental research in recommendation systems and agentic AI. The classic literature in the field confirms that two dominating factors of the modern user modelling are content-based and collaborative filtering. Moreover, deep learning designs have re-invented personalization as the systems can process multimodal inputs such as images and reviews.

Studies in conversational interfaces have highlighted that contextual preservation and conversation flow are the most important processes that assistants need to interpret queries on their own. Recent work on agentic AI suggests a modular structure in which an agent coordinates with other modules such as search APIs and recommendation engines such that generative reasoning is based on structured means of reliability and trust.

III. System Architecture And Methodology

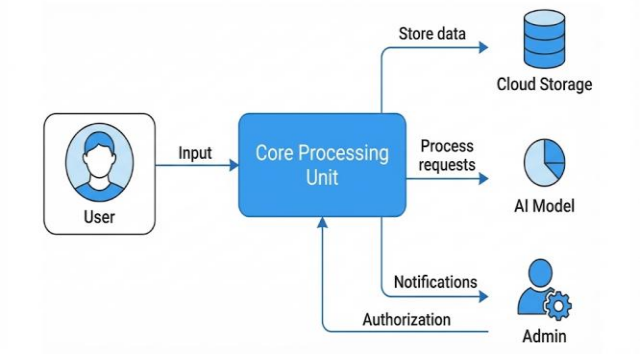

Figure 1: Data Flow Diagram of E-Commerce Shopping Agent

The core goal of the project is to create an AI-based e-commerce agent that will help to improve the online shopping experience with the help of intelligent automation. The goal of the system is to offer customized suggestions, natural conversational support, and multi-criteria search of products with a smooth interface. The methodology is systematic and starts with the analysis of the requirements through requirement analysis and then backs the implementation using FastAPI. This was a modelled SQLite database containing ten tables to store product, user, order and analytics information and ensure easy retrieval and consistency. The AI part of the system incorporates the Google Gemini API to allow the agent to conduct a multi-step reasoning process and activate certain tools to perform a task of comparison or filtering.

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IV. Implementation And Design Of A System

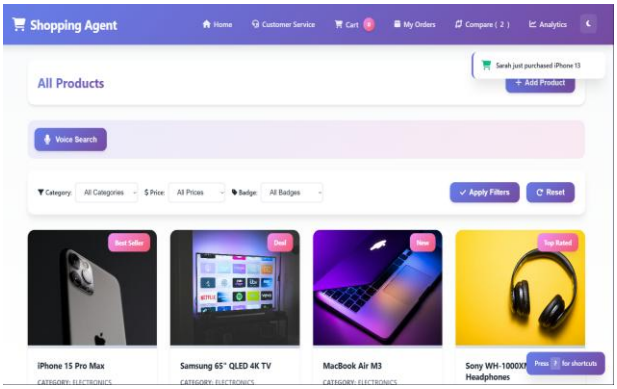

Figure 2: Primary Shopping Agent dashboard

Detailed design phase involves the translation of the requirement specifications into logical structure that is depicted as Data Flow Diagrams and Use Case diagrams. The Data Flow Diagram shows that the user can input the text or voice through the frontend and the FastAPI backend processes it. In case of an intelligent query, e.g. request, a recommendation, it is sent to the Gemini API which determines the intention and activates one of the 48 tools possible. The flow of messages discussed can be used to show how the system makes use of tool calling to base the reasoning of the AI on actual data in the database and not create hallucinations. This architecture is such that the product presented to the user is natural and technically correct.

V. Algorithmic Framework

The system uses a collection of lightweight, but effective algorithms to provide the main functionalities. Content-Based Recommendation Algorithm is a personalized algorithm that is concerned with extraction of product features, including category, price, and rating, and then uses weighted scoring system to calculate similarity. In tandem to this, the Multi-Criteria Search Algorithm optimizes the speed of search using conditional pruning with respect to a variety of filters. The Order Status Transition Algorithm provides operational integrity of a controlled finite-state workflow. Lastly, the Conversational Agent Tool Algorithm is used to handle user communication through the process of parsing natural language queries and therefore identifying intent and invoking the relevant backend tool.

VI. Results And Evaluation

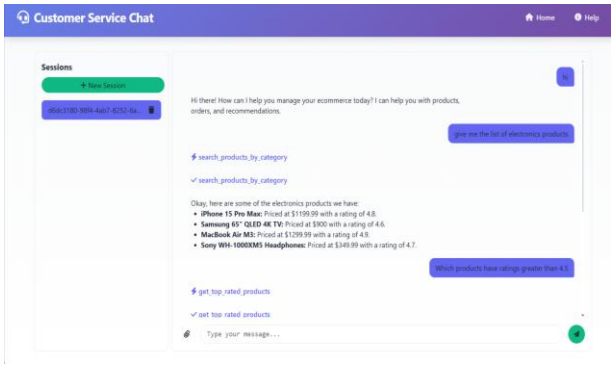

Figure 3: Conversational AI Agent execution

The stability of the agentic workflows was tested systematically. The conversational agent was very accurate with the query that involved budget questions like "Suggest best phones under 20,000" etc. Moreover, the organized database enabled the agent to offer grounded perspectives on category advancement pattern and information on specific sellers. The efficiency of the FastAPI and SQLite integration was confirmed by the performance metrics that showed sub-second latency of search operations.

VII. Conclusion And Future Scope

This project adequately proves the case of a smart e-commerce platform which incorporates both the conventional retail processes with the contemporary autonomous features. The system is very user-friendly in terms of its conversational agent and smart suggestions. The introduction of real payment gateways such as UPI and PayPal is also listed among other strategic improvements that can be deployed in the future. It is also possible to enhance the intelligence of the system by adding transformer-based ranking models and computer vision in searching products based on the images. And the last, but not the least, the use of multilingual assistance will make it more accessible to the international audience.

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