

Conceptual Design of an LLM-Based Tech Product Recommendation System Using LangChain, LangGraph, Firecrawl, and n8n with RAG, Fine-Tuning, Prompt Engineering, and KNN with Cosine Similarity

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Abstract: Choosing the right technology product has become increasingly difficult for consumers due to limited technical knowledge, rapidly evolving specifications, and the overwhelming number of available options. Traditional recommendation systems rely on static filters or keyword-based searches, often producing incomplete or context-insensitive results. This paper proposes a conceptual design for an AI-driven recommendation framework that leverages Large Language Models (LLMs) to deliver accurate, explainable, and personalized product suggestions. The system integrates LangChain and LangGraph to manage reasoning, tool orchestration, and multi-step control flow, while product similarity is computed using K-Nearest Neighbors (KNN) with cosine similarity. To ensure factual grounding and reduce hallucination, the design incorporates Retrieval-Augmented Generation (RAG), complemented by fine-tuning and prompt engineering for domain-specific alignment. A continuously updated product knowledge base, maintained through automated web scraping using Firecrawl and workflow synchronization via n8n, supports real-time data accuracy. The proposed framework enables natural-language interaction and aims to provide reliable recommendations for devices such as smartphones, laptops, and wearables, offering a scalable and modular foundation for next-generation tech product advisory systems.

Keywords: Artificial Intelligence, automation, consumer electronics, cosine similarity, fine-tuning, KNN, LangChain, LangGraph, large language models, prompt engineering, RAG, recommendation system.

