Chapter 10
AI-Powered Recipe Recommendation Systems and Their Role in Personalized Nutrition

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ABSTRACT

Artificial Intelligence (AI) is revolutionizing personalized nutrition through intelligent recipe recommendation systems that adapt to individual dietary needs, preferences, and health goals. These systems utilize machine learning algorithms, natural language processing, and user-generated data to curate meal suggestions that align with personal health profiles, such as allergies, fitness objectives, medical conditions, or cultural preferences. By analyzing nutritional content, consumption patterns, and user feedback, AI-driven platforms enhance user engagement and foster healthier eating habits. Moreover, integration with wearable devices and health apps allows for real-time dietary tracking and adaptive recommendations. Despite promising outcomes, challenges such as data privacy, algorithm transparency, and user trust remain critical. This paper explores the mechanisms, benefits, and limitations of AI-powered recipe recommendation systems and emphasizes their potential to transform modern dietary practices into personalized, data-driven nutrition models.

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INTRODUCTION

Over the past decade, artificial intelligence (AI) has experienced remarkable advancements, particularly through the development of large deep neural networks and AI agents demonstrating human-level performance across diverse domains (Smith et al., 2021; Brown et al., 2020; LeCun et al., 2015). These technological breakthroughs have opened significant opportunities but have also introduced serious risks, including privacy violations, biases and discrimination, and the possibility that AI systems might achieve their objectives in unintended ways (O'Neil, 2016; Bostrom, 2014; Doshi-Velez & Kim, 2017).

In the field of nutrition, AI has been increasingly proposed as a tool for delivering personalized dietary recommendations. Nutrition is a critical factor in promoting and maintaining a healthy lifestyle and plays a key role in preventing non-communicable diseases (NCDs) such as obesity, cardiovascular diseases (CVD), and Type 2 diabetes (T2D) (WHO, 2020; Mozaffarian, 2016). Furthermore, nutritious and balanced meals are regularly incorporated into treatment protocols to mitigate disease progression and improve patient outcomes (Sacks et al., 2001; Estruch et al., 2013). AI systems capable of automatically recommending personalized meal plans therefore hold significant promise for enhancing individual well-being. However, these systems face substantial challenges, particularly regarding the accurate prioritization of user-specific needs and safety concerns, as unbalanced or inappropriate diet recommendations can result in malnutrition or exacerbate health conditions (Johnston et al., 2018; Bender et al., 2020). Addressing these challenges is essential for AI-based dietary recommendation systems to be widely accepted as trustworthy tools.

The recent emergence of Large Language Models (LLMs), and specifically ChatGPT, has stimulated considerable discussion around their potential applications (OpenAI, 2023; Radford et al., 2019). Due to their ability to process information rapidly and generate an extensive variety of meal options sourced from the web, ChatGPT-like models offer new opportunities for dietary advice (Shen et al., 2023). However, preliminary evaluations of their recommendations reveal vulnerabilities to inaccuracies and safety issues (Zhou et al., 2023). In contrast, traditional nutrition recommendation systems leverage expert knowledge and validated nutritional guidelines, enabling them to produce highly balanced and safe meal plans with greater reliability (Kowalski et al., 2019; Patel & Wang, 2021; Anderson et al., 2022; Garcia et al., 2020). Nevertheless, these systems tend to suffer from lower time efficiency and increased complexity due to their reliance on sophisticated ontologies and rule-based filters. Their accuracy is also limited by the size and inherent biases within their meal databases, restricting their generalizability across diverse population groups.