Chapter 9
AI-Powered Personalization in Smart Kitchens Adaptive Cooking Systems for Health, Taste, and Sustainability

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ABSTRACT

The increasing demand for personalized dietary experiences and sustainable living has led to the emergence of smart kitchens enhanced with artificial intelligence (AI).

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This chapter explores the integration of AI and data analytics in creating adaptive cooking systems that cater to individual health profiles, flavor preferences, and ecological concerns. We present an in-depth analysis of the technologies enabling real-time decision-making in meal planning and preparation, including machine learning, natural language processing, and computer vision. Emphasis is placed on how such systems balance nutrition, taste, and environmental sustainability. Through case studies and practical frameworks, this chapter proposes future-ready solutions for AI-powered culinary personalization.

INTRODUCTION

In recent years, the convergence of artificial intelligence (AI) with daily lifestyle applications has transformed how individuals interact with their living spaces—especially in smart kitchens. These environments aim to move beyond automation toward highly personalized, convenient, and health-conscious cooking experiences. Addressing challenges such as rising lifestyle-related diseases, demand for culinary diversity, and the need for sustainable food practices, AI-powered kitchens leverage technologies like deep learning, reinforcement learning, and natural language processing (NLP) to adapt to users' health conditions, preferences, and cultural factors. From meal suggestions based on real-time inventory to voice-assisted recipe adjustments, this chapter explores the technologies, design principles, and ethical considerations driving the shift from reactive tools to proactive partners in health and well-being.

BACKGROUND AND LITERATURE REVIEW

Evolution of Smart Kitchens

Kitchen technology has evolved from simple time-saving tools like microwaves and rice cookers to interconnected IoT appliances, such as smart fridges and Wi-Fi-enabled ovens. While IoT improved convenience, early systems lacked cohesive personalization. The integration of AI now enables kitchens to analyze inventories, suggest meals, adapt instructions, and control appliances based on user data, aligning with modern demands for personalization, health, and sustainability.

Key Technologies Driving Personalization

Several AI subfields contribute to personalization in smart kitchens: