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TastyLens-AR: An AI-Powered Smart Food Ordering System with Adaptive Learning

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Abstract

Traditional food ordering platforms lack personalized recommendations and real-time visualization, leading to dissatisfaction and food waste. TastyLens-AR integrates AI-driven adaptive learning and Augmented Reality (AR) to enhance food selection, allowing users to see realistic 3D projections before ordering. A multi-agent AI framework powers meal suggestions, dynamically optimizing choices based on health, taste, and sustainability using deep learning, NLP, and computer vision. Blockchain technology ensures secure transactions and transparent sustainability tracking. Additionally, web data extraction enhances recommendations with real-time food trends and health insights. The system adapts to dietary restrictions, seasonal trends, and evolving consumer preferences, promoting eco-friendly dining and reducing food waste. Future advancements may include AI-powered restaurant analytics, cooking assistance, wearable nutrition tracking, and voice-enabled food ordering, offering a smart, engaging, and user-centric dining experience.

Keywords: Adaptive Learning, Augmented Reality (AR), Deep Learning, Blockchain Technology, Personalized Meal recommendations.

1. Introduction

The food industry has evolved with the technological improvements and the challenges in the personalization, meal visualization, and transparency persists. Traditional food ordering platforms provide static menus that fail to consider individual user preferences, often leading to dissatisfaction and increases of food waste [1]. Customers frequently experience difficulty with visualizing their portion sizes, ingredients, and presentation, resulting in the ordering errors and with the mismatched expectations [2].

In addition to that, lack of transparency in food sourcing, nutritional value, and sustainability factors prevents consumers from making informed choices about their meals [3]. Artificial Intelligence (AI), Augmented Reality (AR), and Blockchain technology offers solutions to these challenges. Artificial Intelligence has emerged as a solution to enhance meal personalization by analysing suggestions based on the user behaviour, emerging food trends [7]. AI powered recommendation system utilizes deep learning algorithms to refine meal suggestions based on real time user feedback and ensuring more accurate, context aware recommendations [8].
Many food ordering platforms fail to integrate AI based adaptive learning, leading to statics, limit their ability to provide personalized meal recommendations [9]. Augmented Reality (AR) further enhances the online food ordering experience by allowing the users to interact with digital food menus by offering 3D meal visuals before making a purchase [4]. Studies indicate that Augmented Reality integrated food ordering application improves consumer engagement over the application, reduces ordering errors, and increases purchase confidence [5]. Despite these benefits, the adoption of AR in food delivery services remain low, limiting its impact on user decision making [6]. The integration of AR technology can help customers make online food purchases more accurate and volatile [11].

Blockchain technology plays an important role in ensuring transparency, security, and ethical sourcing in food sustainability [12]. Food tracking systems in blockchain provide through immutable, tamper-proof records [13]. However, the mainstream food delivery platforms have been slow to adopt blockchain for food verification making it difficult for customers to gain trust, authenticity [14]. By integrating Artificial Intelligence powered personalization, Augmented Reality based visualizations, and blockchain enabled transparency, TastyLens-AR presents a comprehensive solution to sustainable dining challenges.

2. Related Work

The food industry has been rapid advancements with integration of AI, AR, and blockchain, aiming to enhance personalization, visualization, and transparency. Traditional platforms lack adaptability, leading to food waste, and customer dissatisfaction [1]. The introduction of AI-driven approaches offers a more adaptive solution by leveraging user behaviour, user preferences, evolving trends and real-time feedback to refine their meal suggestions dynamically [2].

Recent research highlights the role of multi-agent AI frameworks in enhancing recommendation systems. These frameworks utilize agents like generation, reflection and ranking agents to iteratively enhance food recommendation by analysing historical and real-time user data [3].

Augmented reality has emerged as a transformative tool in food ordering, ensuring real time visualization of food to users in 3D before making a selection. Research suggests that AR-based food visualization significantly enhances customer engagement, reducing order errors, and increasing purchase confidence [5]. However, the potential benefits of AR-driven applications in improving consumer decision-making and satisfaction [7].

In addition to enhancing transparency, blockchain plays a crucial role in supply chain operations. The immutability of blockchain records enhance consumers to trust in meal sourcing and nutritional data [10]. Research indicates that leveraging blockchain with IoT devices for real-time tracking can further strengthen food safety measures, ensuring authenticity and freshness in meal deliveries [11]. This approach supports a zero-hunger initiative by ensuring transparency and ethical sourcing.

TastyLens-AR integrated AI-driven adaptive learning, AR-based meal visualization and blockchain-based transparency to redefine the food ordering experience. By leveraging AI agents for personalized recommendation, AR for immersive visualization, and blockchain for secure transactions, the system aims to enhance user engagement, promote sustainability, and reduce food waste [13]. Future advancement may include AI-powered cooking assistance, wearable-based nutrition tracking, and voice-enabled food ordering to further enhance the dining experience.

3. Proposed System

Tastylens-AR leverages artificial intelligence, augmented reality, and blockchain technology to enhance the food ordering experience by providing personalized food recommendations, real-time meal visualization, and transparent food sourcing. The platform employs an AI-driven adaptive learning that dynamically refines the meal suggestion based on user preferences, nutritional requirements, and sustainability factors. This adaptive framework incorporates multi-agent with three core agents: a generation agent that suggests meals based on historical data and emerging food trends, a reflection agent that adjusts recommendations based on user satisfaction, and a ranking agent that optimizes meal choices by considering nutrition values, taste preferences, and sustainability factors.

The system enhances user engagement by incorporating augmented reality to provide realistic 3D meal previews before ordering. AI-powered image-to-3D conversion techniques enable meal visualization, allowing users to view portion sizes, ingredients, and presentation, bridging the gap between expectation and reality in online food ordering. By offering an immersive and engaging interface, this AR-based visualization enhances customer confidence, reduces mismatched expectations, and minimizes food waste. The AI model also incorporates external data sources, including seasonal food trends and dietary guidelines, to enhance its predictive capabilities and provide well-balanced meal options that aligns with user needs.

To ensure food authenticity and ethical sourcing, blockchain technology is incorporated to create an immutable tamper-proof record of meal origins, ingredient sourcing, and sustainability ratings. Smart contacts are implemented to automate verification processes, allowing users to access trusted information about food quality, safety, and sustainability. Customers can access blockchain records via a QR code linked to their selected meal, allowing them to make informed choices regarding food quality and sustainability. This feature fosters consumer trust and promotes responsible consumption by offering full transparency in the food industry.

The TastyLens-AR system follows a structured workflow where users first input their dietary preferences, which the AI model processes to

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generate personalized meal recommendations. The AR visualization module then provides a real-time 3D preview of the selected meal, allowing users to interact with their choices before making a final decision. Once the order is placed, blockchain verification ensures food authenticity before transaction completion. A continuous feedback loop captures user satisfaction and behavior insights, refining the AI model's future recommendation to enhance meal personalization.

To illustrate the interaction between AI-driven personalization, AR visualization, and blockchain-based transparency, a system architecture block diagram is mentioned in Fig 1.

As shown in the block diagram, the system begins with user input, where preferences, dietary restrictions, and past interactions are analyzed by an AI-based recommendation engine to generate personalized meal suggestions.

The AI model continuously updates itself using reinforcement learning techniques, ensuring that user preferences evolve dynamically over time based on behavioral patterns and feedback. By leveraging deep learning models. The system analyzes real-time feedback, reviews, and order patterns to continuously optimize meal suggestions, ensuring a more tailored and engaging user experience.

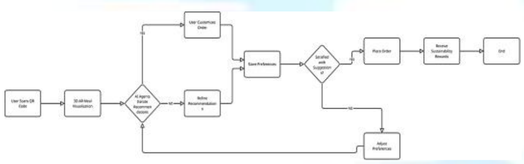

Fig. 1 Overall Architecture

By integrating AI-driven learning, AR-Based visualization, and blockchain transparency, TastyLens-AR provides a seamless, intelligent, and user-centric approach to online food ordering. By leveraging cloud-based storage and computing power, the AI model processes large-scale user data efficiently, ensuring quick response times and real-time personalization. Future advancements may include AI-powered cooking assistance, wearable-based nutrition tracking, and voice enabled ordering, further enhancing the digital dining experience. Through the seamless integration of adaptive AI learning, AR visualization, and Blockchain security, TastyLens-AR redefines digital food ordering by offering a smart, engaging, and transparent dining experience. The comparison and framework is discussed in the following Table 1.

Table 1: AI-Driven Meal Recommendation Framework

Agent Name	*Function*	*Key Benefit*	*Limitation*	*Future Enhancements*
Generation Agent	Suggests meals based on trends	Personalization and variety	Struggles with new diet restrictions	Advanced AI for real time preference updates
Reflection Agent	Adapts recommendations based on feedback	Increases user satisfaction	Needs large user data	AI-driven automated feedback collection
Ranking Agent	Optimizes choices based on health & taste	Ensures balanced meal selection	May not match cravings	Dynamic ranking based on user emotions

4. Results and Conclusion

TastyLens-AR introduces an innovative conceptual framework that redefines food ordering by integrating AI-driven adaptive learning, AR-based visualization, and blockchain-enhanced transparency. Unlike traditional food ordering platforms, which relies on static menus and limited personalization, Tastylens-AR dynamically refines meal suggestions based on real-time user preferences, emerging food trends, and sustainability factors.

The core idea revolves around leveraging an adaptive learning AI model to refine meal recommendations in real time while allowing users to visualize their meal in 3d before making a purchase. By incorporating blockchain technology, the system also provides immutable records of food sourcing, allowing customers to verify the authenticity, nutrition value, and ethical sourcing of their meals, fostering greater trust in the food industry.

While the proposed system outlines a strong theoretical foundation, its practical implementation may require overcoming certain challenges. The AI-based recommendation model needs to be designed with scalability and efficiently in mind, particularly for new users with limited interaction history. The AR visualization technology must be optimized to lightweight rendering across various devices such as mobile devices and web-based platforms, ensuring seamless experience for all users. Moreover, the integration of blockchain for meal verification should balance transparency with cost-effectiveness. Addressing these factors would optimize the feasibility and accessibility of Tastylens-AR in real world applications.

Future advancement could expand Tastylens-AR to include voice-enabled food ordering, wearable nutrition tracking, and AI-powered meal planning. Additionally, exploring IoT-enabled freshness monitoring and predictive analytics for food trends and decentralized food supply networks using blockchain could further enhance transparency in the food industry. By integrating AI, AR, and blockchain into a unified system, Tastylens-AR presents a forward-thinking vision for an intelligent, immersive, and trustworthy food ordering experience, with the potential to reshape the future of digital dining.

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