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A Novel Green Information System for Catering Business

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Abstract: In today's society, with the widespread adoption and enhancement of healthy eating habits, people have paid unprecedented attention to their nutritional needs. This trend is not only a reflection of the pursuit of quality life but also a sign of strengthened health management awareness. Therefore, consumers no longer merely satisfy their desire for food when choosing catering services, but place greater emphasis on the nutritional value and health benefits of dishes. This shift has driven the catering industry towards greener and healthier development. Based on this, this paper mainly introduces an upgraded green catering management information system designed to record the freshness and nutritional content of food items. It provides real-time nutritional information for customers and can calculate and analyze the total nutritional intake, identifying potential incompatibilities or nutritional imbalances among ordered dishes, and offering comprehensive and personalized nutritional guidance during the ordering process.

Keywords: green information system, catering management, nutrition information.

1. Introduction

As people's awareness of healthy eating increases, customers are increasingly demanding transparency in nutritional information and personalized services from catering businesses. This study proposes an upgraded management information system — green information system for the catering industry that integrates inventory management, nutrient information display, and green eating incentives. By recording the freshness and nutritional content of food items, the system provides real-time nutritional information to customers, offering comprehensive guidance when they order dishes. The development of this system not only meets customers' precise demands for healthy eating but also promotes sustainable and green development in the catering industry, reducing food waste.

Currently, more and more scholars are conducting research on intelligent catering systems. Inoue and Matsusaka proposed a dining detection and future dining table system. [1] This system identifies and stores customers' dining behaviors in real time, understands the current state of dining, and recommends suitable dishes at the right time. Choi et al. presented the u-BabSang system, which recommends appropriate foods in real time based on each person's profile, physiological signals, and perceived environmental information. [2] Pronoza et al. developed an information extraction system, also known as sentiment analysis or opinion mining, aimed at collecting restaurant information from user reviews and outputting it to a recommendation module. [3] Leung and Loo introduced an intelligent dining experience framework that interacts with customers through environment and

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sensory expectation shaping information and images, assisting them with an artificial intelligence system. [4] Tien and Prabhu developed an analytical framework for event planners to make decisions regarding kitchen capacity, temporary storage capacity of warmers, and staffing levels for buffet services in order to minimize food waste. [5] Chung et al. discussed a sustainable food system that not only enhances customer satisfaction but also saves costs, proposing future prospects for a catering information system within mobile dining vehicles to improve service sustainability. [6] Wong et al. proposed the concept of a smart restaurant, using various artificial intelligence robots to build automated and intelligent restaurants, aiming for service automation to reduce virus infection risks through contactless dining. [7] Systems like these combine changing dining environments and optimizing dining processes but seldom consider nutrition and green eating factors.

This study innovates and upgrades upon existing foundations by utilizing a database to store and update detailed nutritional data of food items. It develops intelligent algorithms to recommend complementary and well-matched dishes based on the total nutritional content of customer orders, pointing out potential food incompatibilities or nutritional imbalances. Additionally, a green scoring mechanism is introduced where customers can earn points by choosing healthier dishes or avoiding leftovers, redeemable for small gifts. This approach encourages customers to reduce food waste and pushes the catering industry towards a more environmentally friendly and healthy direction.

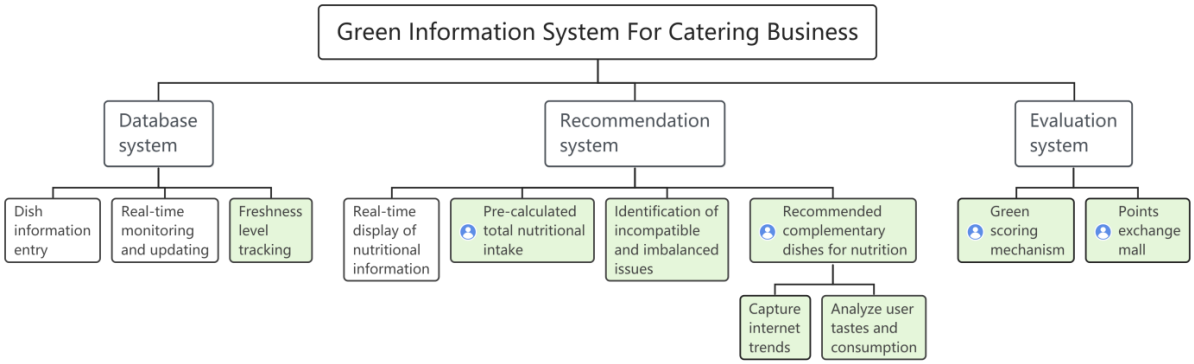

Figure 1: The Functionality of New and Old Green Catering Information Systems

2. The new features of green information system

In traditional catering management information systems, there are typically two subsystems. The first is the database system, which primarily performs functions such as dish information entry and real-time monitoring updates. The second is a recommendation system that features real-time display of nutritional information. These functionalities form the foundation of traditional information systems, ensuring the accuracy and timeliness of dish information. However, with the growing consumer demand for healthy eating habits, merely satisfying basic dish management is no longer sufficient. Therefore, we have upgraded the system with new functionalities. In the database subsystem, we have added a freshness tracking feature. In the recommendation subsystem, we have incorporated features like estimated total nutrient intake, identification of food incompatibilities, and recommendations for complementary dishes in terms of nutrition. Additionally, we have introduced an evaluation subsystem, with a green scoring mechanism and a points redemption mall as its primary functions. The following content will detail the new features of green information system.

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2.1. Freshness level tracking

The freshness tracking feature is built upon the foundation of traditional database functions for dish information entry and real-time monitoring updates, aiming to determine the usability and shelf life of food items through precise recording of their freshness levels. This system assigns a unique batch number to each ingredient and records data such as the batch number, corresponding ingredient information, and storage time in the database. Utilizing the batch tracking function allows for the quick location of problematic ingredients for recall or disposal, thereby achieving traceability and management of the ingredients.

The implementation of this feature relies on a freshness sensor technology that comprehensively detects changes in the physical characteristics, chemical indicators, and biological components of food. [8] The sensors are highly sensitive to any characteristic changes exhibited during the degradation process of the monitored ingredients, capturing aspects like bacterial growth and changes, as well as the release of decay-related gases, thereby accurately reflecting the freshness state of the food. Before using the sensors, detailed internal freshness indicators and thresholds must be set for each type of food in the database. For vegetables, this may include attributes such as color brightness and temperature; for meats, it could encompass aspects like color, smell, and texture. Threshold settings include but are not limited to parameters like temperature and humidity; they may also involve the concentration of oxygen, carbon dioxide, and ethylene in the ingredients. By simulating the most suitable living environment for the ingredients and combining various factors such as gas concentrations or color textures, a specific calculation method is used to determine the boundary value for judging the freshness of the ingredients.

After capturing relevant data from the ingredients, the same computational model is applied to process these sensor-derived data, generating a corresponding freshness score. The system then compares this score with a preset threshold value. If the score does not reach the threshold, it indicates that the ingredient is still fresh, and at this point, the system utilizes Internet of Things (IoT) technology to real-time update and upload the freshness change data detected by the sensors to the database server. If the score approaches the threshold, the system triggers a preset food expiration warning mechanism in the database, sending alerts to the management personnel when nearing the expiration date. This helps managers take appropriate measures in a timely manner, avoiding food wastage and safety hazards. Once the score reaches or exceeds the threshold, the system immediately initiates a preset handling process, notifying administrators to discard or specially handle the stale ingredients.

Additionally, to enhance customer trust, the system also displays real-time updated data through screens within the restaurant to the customers. This information includes but is not limited to ingredient arrival time, freshness scores, and pictures of the day's ingredients. The system also provides regular internal reports and statistical analyses of freshness data for restaurant managers, covering aspects such as ingredient usage, inventory levels, and any freshness issues that require attention. By identifying key factors affecting ingredient freshness and trends and patterns in food freshness, it assists managers in regularly revising and maintaining the system, optimizing storage conditions or procurement strategies.

2.2. Pre-calculated total nutritional intake

pre-calculated total nutritional intake is a function within the recommendation subsystem of the Green Management Information System. This function is built upon a database of nutritional information for dishes and a point-of-sale interface that already includes nutritional information display capabilities. The implementation of this feature aims to provide customers with a healthier and more scientific dining experience.

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The dish nutritional information database serves as the foundation for this entire function, providing key nutritional data such as ingredients, portion sizes, calories, fat content, protein content, and carbohydrate content for each dish. In the point-of-sale interface, customers can freely choose dishes and view the nutritional information of each dish in real time. Whenever a customer selects a dish, the system automatically interacts with the database to retrieve detailed nutritional data for that dish. The system then calculates the nutritional intake for each dish and accumulates it to determine the total nutritional intake of the selected dishes. For example, if a customer orders two dishes, the system will calculate the nutritional components of each dish separately and add them together to get the total intake. Of course, whenever a dish is added or removed, the system recalculates and updates the total nutritional intake accordingly.

Specifically, the method for estimating nutritional intake involves initializing one or more variables to store the total amounts of calories, proteins, fats, carbohydrates, and other nutritional costs. Then, the system traverses the list of dishes ordered by the customer. For each dish in the list, the system queries its corresponding nutritional information from the database. Next, the system adds the nutritional components of each dish to the respective variables. For instance, if a customer orders a dish with 200 calories and 10 grams of protein, the system adds 200 calories to the total calorie variable and 10 grams to the total protein variable. Finally, the values of all variables are summed to obtain the total nutritional content of the ordered dishes. The calculated total nutritional content is displayed on the point-of-sale interface, allowing customers to understand the nutritional value of their chosen dishes. In this way, customers can clearly understand the nutritional value of their chosen dishes during the ordering process, enabling them to make healthier and more reasonable choices.

2.3. Identification of incompatible and imbalanced issues

This function aims to intelligently analyze the nutritional components of dishes, identifying potential incompatibilities and nutritional imbalances among the dishes selected by customers to prevent health issues caused by improper food combinations. Food incompatibility typically refers to adverse reactions or reduced nutritional value when two or more foods are consumed together. For example, consuming certain seafood with foods rich in vitamin C may cause discomfort. Nutritional imbalance occurs when the proportions of nutrients in a dish are improper, or there is a deficiency or excess of essential nutrients. When customers choose their dishes, the system detects the nutritional information and components in real time to determine if there are any incompatibilities or nutritional imbalances, providing warnings or suggestions to avoid potential health risks.

The premise for identifying dish incompatibilities is establishing a food incompatibility database that collects and organizes common food incompatibility information, including traditional Chinese dietary therapy theories and modern nutritional interactions, storing this structured data for quick querying and matching. When customers select their dishes, the system retrieves the names and attributes of the chosen dishes, automatically searches the database for any potential incompatibilities, and immediately displays a pop-up message on the ordering interface if any are found, suggesting adjustments and highlighting the potential health consequences to increase customer trust in the analysis results.

For nutritional imbalances, a nutritional balance assessment model is established based on recommended standard intake levels from nutrition science. This model calculates the ratio of actual nutrient intake to recommended intake. [9] The system extracts the nutritional information of the selected dishes, including proteins, fats, carbohydrates, vitamins, and minerals, combines it with the estimated total nutritional intake, and analyzes it using the assessment model to evaluate whether the nutrition is balanced. If there is an imbalance, the system indicates whether there is a deficiency or excess of a particular nutrient on the interactive interface, pointing out the health issues associated with the imbalance and suggesting adjustments to the customer's dish selection.

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Finally, machine learning and data mining techniques are used to analyze user feedback, dietary habits data, and historical order data to identify potential incompatibility and nutritional imbalance issues, optimizing the incompatibility and nutritional imbalance databases and analysis algorithms to improve the accuracy and personalization of the suggestions.

2.4. Recommended complementary dishes of nutrition

The Nutritional Complementary Dish Recommendation feature conducts an in-depth analysis of customers' dish selections, taste preferences, and current dining trends, integrating the nutritional components of dishes to intelligently recommend combinations of nutritionally complementary dishes. This recommendation not only meets customers' personalized taste demands but also ensures balanced nutrition for the customers. In conjunction with the content mentioned above, when customers are ordering, the system should simultaneously operate the functions for identifying dish incompatibilities and imbalances, as well as recommending nutritionally complementary dishes. When incompatibilities or nutritional imbalances are detected, the system should prioritize addressing these issues by providing warnings and alternative suggestions. Once these issues are resolved, further recommendations for nutritionally complementary dishes should be provided to meet customer needs.

To implement personalized complementary dish recommendations, information can be collected through two channels: trend analysis from the internet and consumer taste analysis. The internet trend analysis involves using web crawler technology to capture popular dining trends, hot dishes, and flavor trends, updating every two to three days to ensure timeliness. Consumer taste analysis is based on constructing user profiles and flavor models from users' order histories and feedback. Combining these data with the total nutritional intake of the dishes already selected by the customer, the system generates a list of recommended dishes that match the customer's flavor profile and nutritional requirements using collaborative filtering or content-based recommendation algorithms.[10] As customers continue to select dishes, the system must update the recommendation list in real time to ensure it always aligns with the customer's latest dietary choices. For example, if a customer chooses a high-protein dish, the system might recommend a vitamin C-rich dish to aid absorption. Similarly, if a high-carbohydrate dish is chosen, a fiber-rich dish might be recommended to help regulate blood sugar and aid digestion. Implementing this feature requires continuous updating and optimization of the recommendation algorithms, incorporating machine learning and deep learning techniques to enhance accuracy and intelligence, and regularly updating the incompatibility relationships and nutritional databases. In terms of user interaction, after presenting the nutritionally complementary dishes, the ordering interface should automatically display the total nutritional intake post-recommendation, allowing customers to compare the nutritional intake of different dish combinations.

2.5. Evaluation system

This function encourages customers to choose healthier dish combinations by assigning green scores to their ordering behavior and generating corresponding points that can be exchanged for small gifts in the restaurant's point redemption system, thereby improving their dietary quality. The customer's ordering behavior includes the nutritional content of the dishes ordered as well as whether there are leftovers at the end.

The system first sets a comprehensive nutritional scoring standard based on scientifically calibrated nutritional intake standards. It calculates a green score according to the preset scoring criteria based on the total nutritional components of the dishes ordered by the customer. For example, dishes high in fiber and low in fat receive higher scores, while those high in sugar and salt receive lower scores. If the dish combination includes a variety of nutritional components in balanced proportions, it gets higher scores. Additionally, dishes rich in specific nutrients such as vitamin C and

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calcium are also appropriately awarded extra points. If the customer leaves no leftovers or only a small amount after dining, they will receive extra points. As nutritional science evolves and customer needs change, the system regularly adjusts and optimizes the scoring criteria, keeping up with the latest dining trends and health concepts to ensure the scoring mechanism remains scientific and practical. Based on the green scoring results, the system generates points according to certain rules, setting different score ranges to correspond to different point values—the higher the score, the more points awarded. The points earned by customers are automatically accumulated in their accounts, and once a certain threshold is reached, they can be redeemed for small gifts in the point redemption system, such as restaurant souvenirs, eco-friendly utensils, and healthy foods.

3. Conclusions and future works

The green catering management information system proposed in this paper is an upgrade from the traditional management system. The system accurately records the freshness of food to determine its usability and shelf life, and uses sensor technology to detect changes in ingredients, updating and uploading the data in real time to the database. Additionally, it retrieves detailed nutritional data for dishes, automatically calculates the total nutritional intake of dishes ordered by customers, and intelligently analyzes the nutritional components of dishes to identify potential incompatibilities or imbalances. By combining customer preferences for dishes, taste preferences, and current dining trends, the system generates a list of recommended dishes that match their taste profile and nutritional requirements through algorithms, ensuring that dishes match customer needs in terms of both taste and nutrition. Finally, the system scores the dining behavior of customers in a green manner and generates corresponding points, encouraging customers to choose healthier meal combinations. These features not only meet customers' demand for healthy eating but also promote sustainable development in the catering industry.

In the future studies, we can integrate smart inventory and waste management system into our system. For real-time inventory monitoring: implement sensors and IoT devices to track food and supply inventory, reducing over-purchasing and minimizing waste. For waste tracking: Use AI or data analytics to track and predict food waste. The system can provide insights into which menu items or events generate the most waste and suggest adjustments.

References

[1] *Inoue, Tomoo, and Yosuke Matsusaka. "A system to recommend dishes by the real time recognition of dining activity." 2010 IEEE International Conference on Systems, Man and Cybernetics. IEEE, 2010.*

[2] *Oh, Yoosoo, Ahyoung Choi, and Woontack Woo. "u-BabSang: a context-aware food recommendation system." the Journal of Supercomputing 54 (2010): 61-81.*

[3] *Pronoza, Ekaterina, Elena Yagunova, and Svetlana Volskaya. "Aspect-based restaurant information extraction for the recommendation system." Human Language Technology. Challenges for Computer Science and Linguistics: 6th Language and Technology Conference, LTC 2013, Poznań, Poland, December 7-9, 2013. Revised Selected Papers 6. Springer International Publishing, 2016.*

[4] *Leung, Rosanna, and Poh Theng Loo. "Co-creating interactive dining experiences via interconnected and interoperable smart technology." Asian Journal of Technology Innovation 30.1 (2022): 45-67.*

[5] *Tien, Kai-Wen, and Vittaldas V. Prabhu. "Engineering Large Event Catering Services." Advances in Production Management Systems. Artificial Intelligence for Sustainable and Resilient Production Systems: IFIP WG 5.7 International Conference, APMS 2021, Nantes, France, September 5–9, 2021, Proceedings, Part III. Springer International Publishing, 2021.*

[6] *Chung, Jen-Chieh, et al. "The sustainable innovation design in catering service." Sustainability 14.1 (2021): 278.*

[7] *Wong, IpKin Anthony, et al. "Smart dining, smart restaurant, and smart service quality (SSQ)." International Journal of Contemporary Hospitality Management 34.6 (2022): 2272-2297.*

[8] *de Vargas-Sansalvador, Isabel M. Perez, et al. "Smartphone based meat freshness detection." Talanta 216 (2020): 120985.*

DOI: 10.54254/2754-1169/153/2024.19515

[9] *Karikome, Shihono, and Atsushi Fujii. "A system for supporting dietary habits: planning menus and visualizing nutritional intake balance." Proceedings of the 4th International Conference on Uniquitous Information Management and Communication. 2010.*

[10] *Li, Xinke, et al. "Application of intelligent recommendation techniques for consumers' food choices in restaurants." Frontiers in psychiatry 9 (2018): 415*