Eat Wise

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***Abstract* - The "Eat Wise" dietary management system is designed to facilitate enhanced tracking and management of individual nutrition, employing a suite of sophisticated technologies and design principles. By integrating data structures such as lists, collections, maps (HashMaps), binary search trees (BSTs), and graphs, the application ensures efficient data handling and quick retrieval of nutritional information. It adheres to core object-oriented design principles, including encapsulation, inheritance, polymorphism, and recursion, which underpin the system's modular architecture and robust functionality. Developed using JavaFX for the user interface and Java for backend processing, the system offers features like food logging, nutritional tracking, and personalized goal setting. "Nutri Match" and "Nutri Sort" are standout features that leverage graphs and BSTs respectively to help users find similar foods and sort them by nutritional values, enhancing the user experience with interactive and tailored dietary management. Preliminary outcomes from user testing suggest significant improvements in user engagement and accuracy in dietary tracking, with future updates aimed at incorporating machine learning to customize dietary recommendations further. The "Eat Wise" project effectively demonstrates the application of advanced data structures and object-oriented principles in solving real-world problems in health and nutrition management.**

Keywords* - *dietary management, nutritional tracking, JavaFX, Java, data structures, object-oriented design, encapsulation, inheritance, polymorphism, recursion, binary search trees, HashMaps, graphs, user engagement, machine learning, health technology, food logging, nutritional insights, personalized dietary recommendations

I. Problem Description

In the contemporary landscape of health and wellness, managing dietary habits effectively is a critical challenge for many individuals. With the prevalence of lifestyle-related health issues such as obesity, diabetes, and cardiovascular diseases, there is a pressing need for tools that can help users monitor and adjust their dietary behaviors in a personalized and informed manner. Although the market is replete with dietary tracking applications, many of these tools fall short in providing a comprehensive, easy-to-use platform that caters to the diverse nutritional needs and preferences of users.

The "Eat Wise" project was conceived to fill this gap by developing a sophisticated dietary management system that not only tracks caloric intake but also provides a detailed breakdown of macronutrients, vitamins, and minerals. The project's scope includes creating an intuitive user interface that simplifies logging daily food and water intake, setting personal dietary goals, and monitoring progress towards these goals. The system is designed to offer users actionable insights into their eating habits, enabling them to make informed decisions that contribute to better health outcomes.

The purpose of the "Eat Wise" system is twofold: to enhance the accuracy and depth of dietary tracking and to motivate users towards sustained healthy eating habits through a user-friendly and visually appealing dashboard. By leveraging advanced data structures and object-oriented programming principles, the project aims to provide a robust solution that is scalable and adaptable to future enhancements, such as integration with external health databases and incorporation of machine learning algorithms for personalized dietary recommendations.

In essence, "Eat Wise" is not merely a food logging tool but a comprehensive dietary companion that supports users in their journey towards a healthier lifestyle, making it an invaluable addition to the digital health ecosystem.

II. Analysis (Related Work)

Many dietary tracking applications fail to sustain user engagement due to their lack of interactive and personalized features. Payne et al. (2015) reveal that engaging users effectively requires more than basic tracking; it necessitates interactive feedback and adaptability to individual needs [1]. "Eat Wise" addresses this by integrating advanced user interfaces and actionable feedback mechanisms.

Krebs and Duncan (2015) note that usability issues are a significant barrier to long-term app usage [2]. In response, "Eat Wise" delivers clear progress indicators and immediate rewards to maintain user interest and promote sustained app use.

Personalization is another critical feature lacking in many apps. Tang et al. (2015) found that users value applications that provide personalized recommendations [3]. "Eat Wise" employs sophisticated algorithms and data structures to customize dietary advice, enhancing the relevance and effectiveness of its recommendations.

Moreover, Conroy, Yang, and Maher (2014) point out that many health apps do not effectively incorporate behavior change techniques, which are crucial for promoting healthier habits [4]. "Eat Wise" integrates these techniques into its design to foster and sustain healthy eating behaviors.

Finally, according to Michie et al. (2017), digital interventions should be grounded in evidence-based features that promote

behavior change [5]. "Eat Wise" is built on these principles, ensuring both functionality and effectiveness.

In summary, "Eat Wise" overcomes common shortcomings in dietary tracking apps by focusing on engagement, personalization, and scientifically supported behavior change strategies, making it a comprehensive tool for dietary management.

III. System Design

The "Eat Wise" application's architecture is meticulously designed to segregate functionalities into distinct, manageable modules and packages. This strategic partitioning facilitates maintainability, scalability, and enhances overall system organization. Each package is tailored to handle specific areas of the application, from core data handling and business logic to user interaction layers. Here's a detailed breakdown of the system design, emphasizing the roles and responsibilities of various system packages:

A. System Architecture:

a. Presentation Layer: Built using JavaFX and FXML, this layer manages all user interactions with the system. It is responsible for rendering the graphical user interface, handling inputs, and displaying data in various forms such as login pages, dashboards, and food logs.
b. Application Logic Layer: Implements core functionalities like session management, feature accessibility, and data processing. Java classes and interfaces are used extensively to handle the logic behind user authentication, data input, and the tracking of dietary goals.
c. Data Access Layer: Utilizes sophisticated data structures and algorithms for efficient data storage and retrieval. This layer employs lists, maps (HashMaps), binary search trees (BSTs), and graphs to organize and manage user data, meal logs, and nutritional information effectively.
d. Database Layer: Relies on a files to store persistent data such as user profiles, food item details, and historical logs. It provides interfaces for the application logic layer to retrieve and store data as required, ensuring data consistency and reliability.

B. Model Packages:

a. model.implementation:
- Description: Contains the core data models and business logic essential for processing dietary data. This package includes classes like User, FoodItem, and NutritionalInfo, which define the data structure and include methods essential for operations such as nutrient analysis and dietary recommendations.
- Role: Central to operations that calculate daily caloric intake, analyze nutrient compositions, and provide tailored dietary recommendations based on user-specific data.

b. model.io:
- Description: Focuses on input/output operations related to data persistence. It manages data storage and retrieval operations, ensuring data integrity and security.
- Role: Handles all interactions with the database, including saving user data, retrieving dietary logs, and managing data backups through robust database management using JDBC.

c. model.manager:
- Description: Comprises management classes that orchestrate data operations and encapsulate complex business logic.
- Role: Acts as a mediator between the model components and the application's front end, simplifying data queries and operations while reducing dependencies among components.

d. model.util:
- Description: Provides utility classes for data manipulation and supports algorithmic operations that are crucial for system functionalities.
- Role: Implements utilities like sorting and searching algorithms which are vital for features such as Nutri Match and Nutri Sort, aiding in efficient data handling and operations.

C. View and Controller Package:

a. view_controller.fxml:
- Description: Handles all aspects of the user interface using JavaFX. This package contains controllers that correspond to FXML files, which define the layout and visual elements of the application.
- Role: Responsible for rendering the user interface, handling user interactions, and updating the GUI in response to user actions and system events. Ensures the UI is intuitive and responsive.

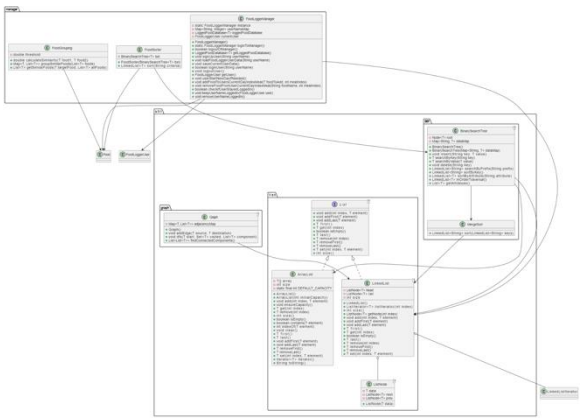

Figure 1. UML Diagram for the system design.

IV. IMPLEMENTATION

The implementation of the "Eat Wise" application involved several key components, including the use of external libraries, implementation of core functionalities, and integration of RESTful APIs. Here's a detailed breakdown of how these elements were brought together to create a comprehensive dietary management system:

A. UI Design and Controllers:

a. NewLoginUI.fxml
   - Purpose: Sets up the login interface for user authentication.
   - Components: Includes text fields for user credentials and buttons for submission or registration.
   - Controller: NewLoginController.java manages user authentication, error handling, and transitions to the main dashboard upon successful login.

b. DashBoard.fxml
   - Purpose: Acts as the primary user interface displaying summary data of nutritional intake and goal progress.
   - Components: Features widgets like progress bars and pie charts.
   - Controller: DashboardController.java updates UI elements based on user data and manages navigation.

c. FoodLoggerGUI.fxml
   - Purpose: Facilitates the logging of daily food intake.
   - Components: Form inputs for meal data and a display area for logged meals.
   - Controller: FoodLoggerGUIController.java processes data entries and communicates with the backend for data persistence.

d. NutriMatchScene.fxml
   - Purpose: Helps users find foods with similar nutritional profiles.
   - Components: Search fields and display areas for food suggestions.
   - Controller: NutriMatchController.java calculates and displays similar food options.

e. WaterIntakeTracker.fxml
   - Purpose: Tracks daily water intake.
   - Components: Interface with buttons for logging water consumption.
   - Controller: WaterCheckController.java updates and displays water intake metrics.

f. AdjustGoalScene.fxml
   - Purpose: Enables users to set and modify dietary goals.
   - Components: Sliders and input fields for defining goals.
   - Controller: AdjustGoalController.java handles goal adjustments and updates the system with new user targets.

g. AdjustDayScene.fxml
   - Purpose: Allows users to correct or update past entries in their food log.
   - Components: A calendar interface and editable fields for past entries.
   - Controller: AdjustDayController.java ensures that changes are reflected accurately across the user's data.

h. NutriSortScene.fxml
   - Purpose: Sorts food items based on nutritional criteria.
   - Components: Dropdown menus and a sortable display for food items.
   - Controller: The NutriSortController.java file implements sorting algorithms to organize and present food data.

In the "Eat Wise" application, RESTful API services facilitate essential CRUD operations, enhancing user interaction and data management related to dietary tracking and user account settings. These services are divided into two main functionalities: Food Item Management and User Account Management.

B. Food Item Management

a. Create: Users can log new food entries, where each entry includes details like food name, calories, meal time, and date. The system automatically generates a unique identifier for each food item to track it individually in the user's dietary log.
b. Update: This functionality allows users to modify existing food entries. Modifications may include changes to food quantity, meal time, or nutritional information, reflecting accurate dietary intake.
c. Read: Users can retrieve detailed information about specific food items or a summary of their daily or weekly nutritional intake. This operation is vital for monitoring dietary habits and making informed decisions.
d. Delete: If an entry is made in error or a user opts to remove a certain food item from their log, the delete operation ensures that the item is permanently removed from the system, keeping the dietary log accurate and up-to-date.

C. User Account Management

a. Create: New users can register for an account by providing necessary information such as username, email, and password. The system validates the information and creates a new user profile.
b. Update: Existing users can update their account details at any time, including password changes and email updates, ensuring their profiles remain current and secure.
c. Read: Authentication checks are performed using this endpoint. Whenever users log in or access secured areas of the application, the system verifies their credentials against the stored data.
d. Delete: Users can delete their accounts, which removes all associated data from the application, ensuring user privacy and data protection.

V. EVALUATION

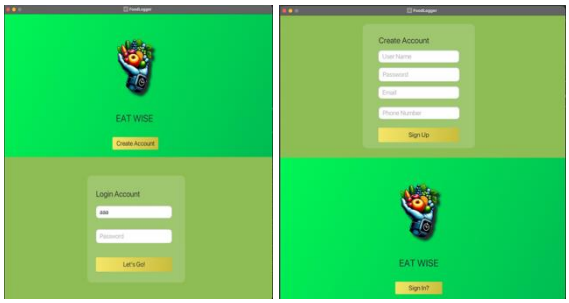

Figure 2. Login and Sign up page with transformations

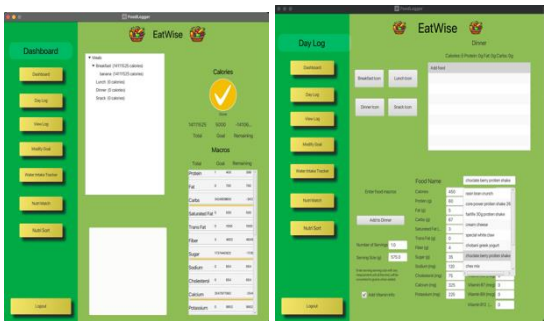

Figure 3. DashBoard and Day Log

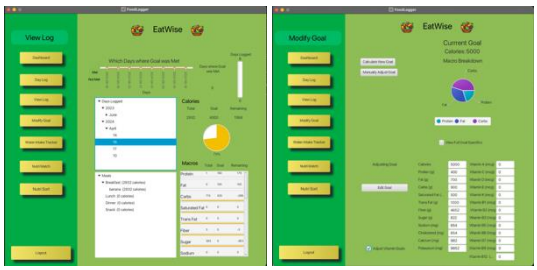

Figure 4. View log and modify goal

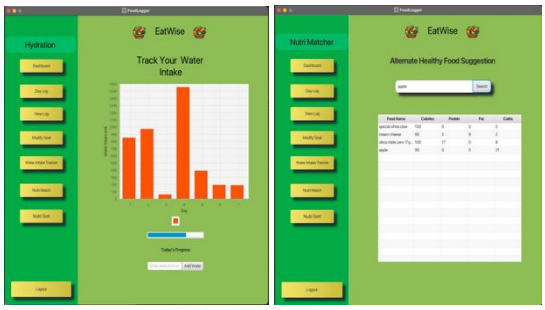

Figure 5. Hydration and Nutri Match

Figure 6. This is Nutrisort

VII. DISCUSSION (REFLECTION)

The "Eat Wise" project has demonstrated its viability as a dietary management tool through rigorous development and testing phases. This section reflects on the unique outcomes, unexpected results, and insightful observations gained during the project lifecycle, expanding beyond initial findings to delve deeper into the application's broader implications and potential for future research.

Impact on User Dietary Awareness and Education:

A surprising outcome from the project was the significant increase in dietary awareness among users. The application not only facilitated easier tracking of dietary intake but also educated users about nutritional values, leading to more informed food choices over time. This educational aspect was enhanced by the visual data representations and breakdowns of nutritional content, which users reported as highly informative. This suggests that dietary tracking tools can play a crucial role in nutritional education and potentially influence public health positively.

Nutritional Tracking and Behavior Influence:

The application's comprehensive nutritional tracking received positive feedback for its detailed breakdown of nutrients, which educated users and assisted in making informed dietary choices. The high consistency in meal logging indicated the app's potential to positively influence dietary habits and provided a foundational dataset for analyzing dietary trends.

Personalization and User Experience:

Features like Nutri Match and adjustable goals personalized the user experience, increasing the app's relevance to individual dietary needs. However, users expressed a desire for more adaptive personalization, suggesting the integration of machine learning to refine recommendations over time.

Behavioral Changes and Long-Term Engagement:

The project data indicated that sustained use of the "Eat Wise" application correlated with healthier eating habits among users. Interestingly, those who engaged with the app for more than a month showed measurable improvements in their dietary choices, such as increased consumption of fruits and vegetables and a reduction in processed foods. This long-term engagement points to the potential of such tools to support lasting behavioral changes, a key aspect that could be highlighted in health promotion and disease prevention strategies.

Adaptability and User-Centric Design:

Feedback from the user study revealed that adaptability was highly valued, with users appreciating the ability to customize features such as dietary goals and tracking preferences. This adaptability not only improved user satisfaction but also encouraged regular use, which is essential for the success of any health-oriented app. The importance of a user-centric design in health applications cannot be overstated, as it directly affects user retention and effectiveness of the intervention.

VIII. Conclusions and Future Work

The "Eat Wise" project successfully demonstrates its effectiveness as a user-friendly application for enhancing dietary management. This section summarizes the project's outcomes, highlights benefits, notes development challenges, and proposes areas for improvement.

Conclusions:

A. "Eat Wise" offers notable advantages:

a. Enhanced User Engagement: The JavaFX interface promotes frequent interaction, essential for accurate dietary logs.
b. Comprehensive Nutritional Tracking: Provides insights into macronutrients and micronutrients, supporting informed dietary choices.
c. Personalized Dietary Management: Features like goal setting and Nutri Match customize the app to user needs, enhancing personal value.

B. Key challenges include:

a. Scalability and Performance: As the user base expands, efficiently managing large data volumes and user interactions is crucial.
b. Real-Time Data Integration: The lack of real-time updates from external databases may impact the accuracy of nutritional information.
c. Advanced Feature Integration: Time constraints prevented the implementation of social sharing and community challenges.

Future Work:

a. Database Enhancement: Transitioning to a more scalable database system to handle growth.
b. Machine Learning and AI: Integrating AI for personalized recommendations and automating food logging.
c. Mobile Platform Expansion: Developing a mobile version for enhanced accessibility.
d. Interactive Social Features: Adding social functionalities to increase motivation and user engagement.

Final Thoughts:

"Eat Wise" lays a solid foundation as a versatile dietary management tool. With ongoing development to address identified challenges and integrate advanced technologies, it has the potential to evolve into a more powerful aid for improving dietary habits, positioning it as a promising application in the health and wellness sector.

IX. Job Assignment

A. **Abhishek Chintapalli:**

a. UI Design: Responsible for designing the user interface components of the "Eat Wise" application, including layout, styling, and user interaction elements.
b. Login/Signup Management: Develops the functionality for user authentication and account registration, ensuring secure access to the application.
c. Daily Food Logging: Implements the feature for users to log their daily food intake, including input forms, validation, and data submission. In view log page, displayed historic data like past logs with help of **lists and recursion** logic.
d. Integration: Integrates various components and modules of the application to ensure seamless functionality and communication between different parts.
e. **List and Linked List** Implementation: Implements data structures for efficient storage and management of food items and user data. Utilized **Hash Maps** for User Data Management and file io operations
f. Project Report, PPT & UML: Compiles and prepares the comprehensive project report, documenting the design, implementation, and evaluation of the "Eat Wise" application.
g. Field Testing: Conducts rigorous testing of the nutri matcher feature, ensuring that it accurately identifies

and recommends similar food items based on user preferences and nutritional profiles.

B. **Abhishek Sagar Sanda:**

a. User Management: Develops the functionality for managing user accounts, including registration, profile updates, and authentication checks.
b. Dashboard Page: Designs and implements the dashboard page, where users can view summary data of their nutritional intake and goal progress.
c. View Logging: Implements the feature for users to view detailed logs of their food entries, providing insights into their dietary habits over time.
d. Nutri Sorter with **Binary Search Trees**: Develops the functionality to sort food items based on nutritional criteria using binary search trees, ensuring efficient data organization and retrieval. Uses **Merge Sort Algorithm** for sorting.
e. Search Functionality in Nutri Sorter: Uses **BST** and linked list traversal with the help of **recursion** for finding the matched element.
f. Project Report, PPT & UML: Prepares and delivers the project presentation, effectively communicating the objectives, methods, and outcomes of the "Eat Wise" application.
g. Field Testing: Conducts thorough testing of the daily food logging feature, ensuring that it functions correctly across different devices and scenarios.

C. **Tirdesh Pettugani:**

a. Food Entry Management: Develops the functionality for managing food entries, including creation, modification, and deletion of food items logged by users.
b. **Nutri Matcher with Graphs and Adjacency Matrix**: Implements the feature to find similar food items based on nutritional profiles using **graphs and adjacency matrices,** providing personalized recommendations.
c. Search Functionality in Nutri Matcher: Uses **depth first search** traversal with **recursion mechanism** to go through all nodes and find the needed element.
d. Water Intake Tracker: Logs water intake and gives insightful recommendations for optimal hydration.
e. Project Design: Leads the design phase of the project, defining the architecture, components, and interactions of the "Eat Wise" application.
f. Project Report, PPT & UML: Creates **UML diagrams** to visualize the project architecture, data flow, and relationships between components, aiding in understanding and communication during development.
g. Field Testing: Conducts extensive testing of the nutri sorter feature, ensuring that it accurately sorts food items based on specified criteria and handles edge cases effectively.

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