Universiti Teknologi MARA
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PCMJ

Progress in Computing and Mathematics Journal

volume 1

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Progress in Computing and Mathematics Journal
College of Computing, Informatics, and Mathematics
Universiti Teknologi MARA Cawangan Melaka, Kampus Jasin
77300, Merlimau, Melaka Bandaraya Bersejarah

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EDITORS

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PREFACE

Welcome to the inaugural volume of the **Progress in Computing and Mathematics Journal (PCMJ)**, a publication proudly presented by the College of Computing, Informatics, and Mathematics at UiTM Cawangan Melaka.

This journal represents a significant step in our commitment to fostering a vibrant research culture, initially providing a crucial platform for our undergraduate students to showcase their intellectual curiosity, dedication to scholarly pursuit, and potential to contribute to the broader academic discourse in the fields of computing and mathematics. However, we envision PCMJ evolving into a beacon for researchers both nationally and internationally. We aspire to cultivate a space where groundbreaking research and innovative ideas converge, fostering collaboration and intellectual exchange among established scholars and emerging talents alike.

The manuscripts featured in this first volume, predominantly authored by our undergraduate students, are a testament to the hard work and dedication of these budding researchers, as well as the guidance and support provided by their faculty mentors. They cover a diverse range of topics, reflecting the breadth and depth of research interests within our college, and set the stage for the high-quality scholarship we aim to attract in future volumes.

As editors, we are honored to have played a role in bringing this journal to fruition. We extend our sincere gratitude to all the authors, reviewers, and members of the editorial board for their invaluable contributions. We also acknowledge the unwavering support of the college administration in making this initiative possible.

We hope that PCMJ will inspire future generations of students and researchers to embrace research and innovation, to push the boundaries of knowledge, and to make their mark on the world of computing and mathematics.

Editors
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UiTM Cawangan Melaka

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e-ISSN: 3030-6728
Website: fskmjebat.uitm.edu.my/pcmj

DIETARY SUPPLEMENT OF COLLABORATIVE RECOMMENDATION SYSTEM FOR ATHLETE AND FITNESS ENTHUSIAST

Anis Hafiza Gastani
College of Computing, Informatics and Mathematics,
Universiti Teknologi MARA Melaka (Kampus Jasin),
77300 Merlimau, Melaka, Malaysia
anishafizaperlis@gmail.com

Nur Asyira Naziron
College of Computing, Informatics and Mathematics,
Universiti Teknologi MARA Melaka (Kampus Jasin),
77300 Merlimau, Melaka, Malaysia
asyira132@uitm.edu.my

Mohd Taufik Mishan
College of Computing, Informatics and Mathematics,
Universiti Teknologi MARA Melaka (Kampus Jasin),
77300 Merlimau, Melaka, Malaysia
mtaufik@uitm.edu.my

Article Info

Received: February 2024
Accepted: August 2024
Available Online: October 2024

Abstract

The dietary supplement research identifies challenges in current systems, particularly regarding allergy management within recommendation algorithms for athletes. Existing systems lack robust mechanisms to prioritize and integrate allergy information, raising concerns for athletes with specialized dietary needs. To address this, a tailored recommendation system is proposed, aiming to align with individual athlete preferences, nutritional needs, and prioritize user safety. Developed through collaborative filtering with Singular Value Decomposition (SVD), the system delivers precise suggestions, mitigating risks associated with harmful recommendations. Assessment through black box testing shows commendable ratings for interface functionalities, reinforcing system reliability. Future recommendations include expanding data scraping techniques and exploring advanced collaborative filtering algorithms for enhanced personalization. In conclusion, the proposed system represents a significant advancement in ensuring safe, personalized, and effective supplement recommendations for athletes, fostering trust in their journey towards optimal health and performance.

Keywords: Dietary supplements; Athletes; Allergies; Collaborative filtering; Singular Value Decomposition (SVD)

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INTRODUCTION

Athletes widely rely on dietary supplements to meet their unique nutritional needs and enhance their performance, highlighting the importance of personalized supplement recommendations. Previous studies by Peeling et al. (2019) and Maughan et al. (2018) underscore the prevalence of supplement usage among athletes, yet existing recommendation systems such as Malaysia Supplements, Nutrition Pro, and EJI Nutrition often fail to consider athletes' diverse preferences and needs, resulting in generic suggestions that may not align with individual health conditions or performance goals. Moreover, the inadequate integration of allergy information within recommendation algorithms poses significant risks to user well-being, emphasizing the critical need for improved systems prioritizing user safety and tailored recommendations.

This project aims to address these shortcomings by developing a web-based dietary supplement recommendation system specifically tailored for athletes, particularly in Malaysia. Drawing upon collaborative filtering techniques, specifically the Singular Value Decomposition (SVD) algorithm, the system seeks to provide precise and relevant supplement suggestions based on individual athlete preferences. Promkot et al. (2019)’s study underscores the importance of considering individual athlete preferences and requirements in dietary supplement recommendations, emphasizing the need for personalized approaches to enhance athlete performance and well-being. By incorporating insights from existing research, including Garthe & Maughan (2018), Fodmap et al. (2019), and Rodriguez-Lopez et al. (2022), the project aims to enhance the accuracy and safety of supplement recommendations, fostering trust and confidence among athletes in their pursuit of optimal health and performance.

The scope of the project encompasses the development of a comprehensive recommendation system that integrates information on allergies and dietary requirements while considering athletes' preferences. Utilizing data scraped from reputable supplement websites, the system will offer a diverse range of supplement options tailored to meet athletes' specific needs, such as protein support and weight management. Ultimately, the project seeks to streamline the process of supplement selection for athletes, offering a convenient and efficient solution that contributes to their overall well-being and athletic success.

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LITERATURE REVIEW

Dietary supplements are widely used on a global scale due to the country's rapid growth in the online dietary supplement business and growing consumer awareness of self-care practices aimed at regaining good health, improving blood circulation,improving memory, slowing down the aging process and so on. People nowadays are more inclined to try new things that can benefit themselves (Kaufman et al., 2022). This includes taking dietary supplements that are believed to help them in terms of health and beauty apart from medicines given by doctors and experts. This can be proven by the increase in the use of dietary supplements among adults aged 20 years and above in 2017 to 2018 increased by 63.8% compared to 53% in 2003 to 2006 that has been proved in the article Intarakamhang & Prasittichok (2022).

According to a study by Intarakamhang & Prasittichok (2022), people spend more money on dietary supplements due to the following reasons, which are sociodemographic characteristics, beliefs about the benefits of dietary supplements and history of lifestyle choices. The Dietary Supplement Health and Education Act (DSHEA) of 1994 contained the United States Food and Drug Administration's (FDA)definition of dietary supplements saying that directly ingested products containing "dietary ingredients" used to enhance the diet are known as dietary supplements. The Dietary Supplement Health and Education Act (DSHEA) places dietary supplements,regardless of their physical form, in a separate classification under the broad classification of "foods", not drugs and requires each dietary supplement to be clearly labeled as such.

There are many categories of dietary supplements that can be consumed by everyone according to their age and consumption including adults, children, pregnant women, athletes and others. Each category classified above takes dietary supplements differently according to what needs to be taken. For example, according to research Intarakamhang & Prasittichok (2022), the use of dietary supplements that are very popular among adults and the elderly is the intake of vitamins such as vitamin C, vitamin D, minerals, magnesium and calcium. In addition, taking vitamin B, calcium and multivitamins are also very popular among college students. Not forgetting also traditional medicine such as herbal supplements, which are one of the food

supplements available in this country. Herbal supplements use organic products that have the same similarities as conventional supplements that contain chemicals.

In addition, based on study (Maughan et al., 2018), dietary supplements also come in various forms including functional foods, which are foods that have additional nutrients or have components outside of the normal nutrient composition such as vitamins and minerals. In addition, food that is given a new formulation which food that is made in a simpler form compared to general food such as snack bars or sports drinks that can provide energy. Single nutrient food and multi-ingredient products are also included in this form.

Athlete Dietary Supplement

Dietary supplements for athletes have been described in many ways but none of them are completely accurate. According to the study (Garthe & Maughan, 2018), in general, athlete dietary supplements have many categories including vitamins, minerals, sports food, ergogenic supplements and so on. In addition, the category of supplements for weight gain and weight loss can also be called food. Due to the diversity of complex chemicals and the composition of various physiologically activesubstances, herbal and botanical parts of functional foods that can be classified as foods or supplements are very challenging to analyze and identify. However, the sector has seen significant growth in recent years, partly due to the widespread belief that natural foods are healthier than artificial foods.

Collaborative Filtering

The collaborative filtering recommendation system uses a user's behavior similarity with the ones of other users to provide recommendations for that particular user. According to research (Shi et al., 2018), the collaborative filtering algorithm will collect user preferences and first allocate weight based on the user's preference classification. In order to identify people with similar behaviors, it will analyze individuals based on their preferences (Bahar & Baizal, 2023). Finally, to predict things that are not related to the user, the preferences of comparable users as well as an examination of their similarity and weight are employed. Based on the study (Thannimalai & Zhang, 2021), the collection of various recommended things makes up the set of user preferences, which represents the preferences of all users. The system can identify the

top K users who share the most common preferences by analyzing and calculating the preferences of the target user and other users. The initial recommendation collection is what K users are most interested in.

A. Singular Value Decomposition (SVD)

The limitations of a collaborative filtering (CF)-based approach, especially when dealing with extensive and sparse databases, have led to the exploration of alternative recommender system algorithms. Based on the study (Sun et al., 2021), Singular Value Decomposition (SVD) is widely used for dimension reduction, data compression, and recommendation systems. In the context of a dietary supplement recommendation system, the supplement-user matrix (R) can be decomposed into matrices U, Σ, and V^T, as expressed in equation below.

Eq. (1): (1)

$$R=U\Sigma V^T$$

Here, U represents a matrix capturing user preferences, Σ is a diagonal matrix signifying the singular values, and V^T is another matrix. The system aims to adapt SVD principles to derive essential features by decomposing users' supplement preferences (Ruchitha, 2021). Unlike explicit ratings, the dataset relies on a user engagement metric. A user's rating score for a supplement is determined by the frequency of consumption, as outlined in equation (2) below, where s denotes the rating score, c represents the count of a specific supplement consumed by a user, and t is the total count of all supplements consumed by the user.

Eq. (2): (2)

$$s=c/t$$

Nevertheless, according to the research (Chen, 2022), SVD faces challenges when applied to an explicit rating in the CF-based approach, primarily since users often do not rate most of the products, resulting in user-item rating matrices with numerous missing values. In preparation for singular value decomposition, a crucial step involves filling in these blank

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elements and replacing them in the matrix, thereby transforming it from a sparse matrix to a denser representation. This process is essential for facilitating the application of SVD and addressing the inherent sparsity in the user-item rating matrices. The rating prediction challenge in this system aligns with filling the missing elements in a sparse supplement-user matrix, and SVD facilitates this by leveraging dimensionality reduction to complete the sparse matrix, enhancing the precision of supplement recommendations. It's crucial to note that selecting an appropriate value for the index K is vital in the SVD matrix decomposition according to the study (Liu & Li, 2019). This value dictates the number of singular values considered for the approximate representation, with a higher K resulting in a closer approximation but potentially slower calculations. For a dietary supplement recommendation system, a K value of 50 may be suitable, emphasizing the balance between computational efficiency and accuracy.

METHODOLOGY

A. Use Case Diagram

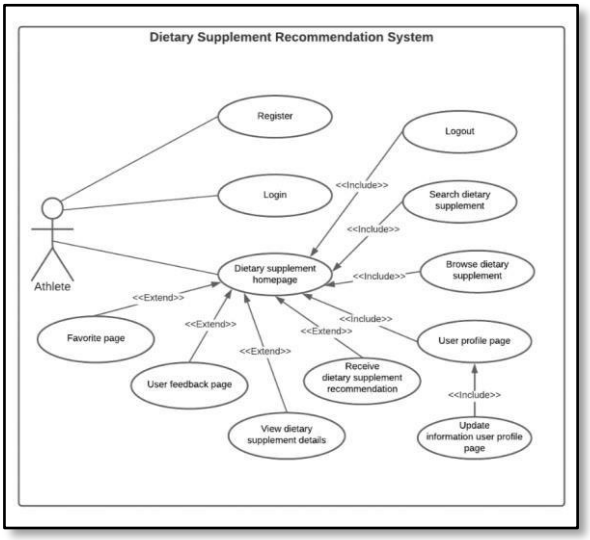

Figure 1: Use case diagram

The system caters specifically to athletes, as depicted in Figure 1, with ten distinct activities outlined in the use case diagram. First, users can register by providing requisite information, including username, email, phone number, and password, ensuring validation

before account creation. Upon successful registration, users log in using their registered email and password, gaining access to the system's dietary supplement homepage, which serves as a central hub for various features. Here, users can search for supplements by name and category, browse a comprehensive catalogue, and delve into detailed information about specific supplements, encompassing nutrition facts, suggested servings, and more. Furthermore, the system provides personalized recommendations tailored to user preferences, enabling the creation of a favorites list for convenient tracking. Users are encouraged to offer feedback on recommended supplements via a dedicated user feedback page, fostering system enhancement and aiding other users in making informed decisions. Additionally, users have access to their personal data on the user profile page, where they can manage and update information such as name, email address, and phone number. Finally, users can securely log out from the homepage to safeguard the confidentiality of their account information and prevent unauthorized access.

B. Flow Chart

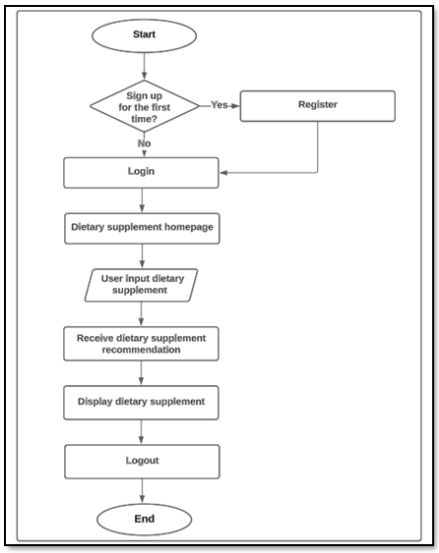

Figure 2: Flowchart of the system

In figure 2 above, the system flow starts with the register process. New users just need to register. Before using the system, the user must first register by providing all the necessary information on the registration form until the user presses the submit button and is considered successfully registered. If not, the user must carry out the process once again. After successfully

registering, users can log into the system with their registered email address and password. Users can access the home page of dietary supplements after successfully logging in. Otherwise, users will be asked to enter their email address and password again. After that, the user must enter the input of the dietary supplement according to their preferences as well as their needs. The system will provide a recommendation to the user and display the result in accordance with their choices. After completing using the system, the user must log out in order to prevent unauthorized access.

C. Collaborative Filtering Recommendation Design

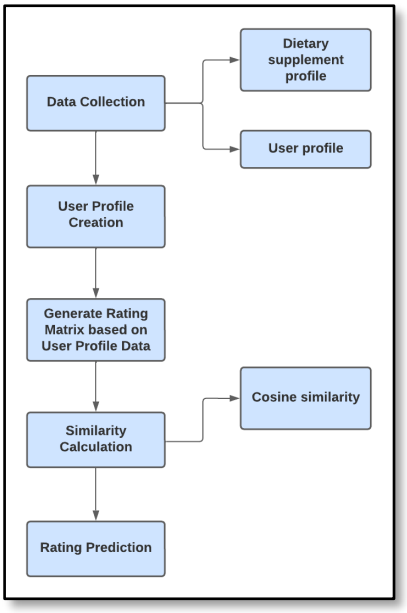

Figure 3: Collaborative Filtering Recommendation Design

Based on figure 3 above, the research design for dietary supplement recommendation started with data collection. The initial step involves gathering data through a combination of data collection and scraping methods, followed by thorough data processing. In addition, information related to dietary supplements such as a list of dietary supplements, a list of nutrition facts, and others can be obtained by using web scraping. Besides that, user information such as user history also needs to be collected and stored in the user profile. All information obtained through web scraping will be processed and stored in the database. Subsequently, user profiles are formulated, incorporating set preferences and specific requirements gathered from

the collected data. In the data preprocessing step, a rating matrix is created based on user profiles, aiding the collaborative filtering algorithm in making recommendations. The algorithm predicts user satisfaction and the probability of choosing specific dietary supplement modes based on ratings. Similarity calculation employs cosine similarity scores to measure similarities between users. In the rating prediction step, the system generates predictions for users who haven't rated certain dietary supplement choices. These predictions, based on user similarities and preferences, offer personalized recommendations. This approach ensures the development of an effective recommendation system tailored to the preferences and needs of athletes and fitness enthusiasts.

RESULT AND DISCUSSION

Functionality Testing

A. Homepage

Based on the diagram in figure 4 below, it illustrates the homepage of the system. There is a navigation bar at the top of the page, containing links to product, favourite, login, user profile, and logout. On the homepage, users can also explore information related to displayed dietary supplements. If users click the "Get Product" button, it will take users to the product page for more detailed options. The navigation bar facilitates access to essential system functions, while the homepage provides an overview of products and useful information for users.

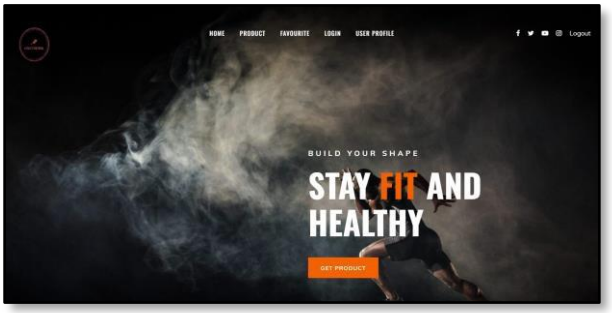

Figure 4: Athlete Nutripal Homepage

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Progress in Computer and Mathematics Journal (PCMJ)
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e-ISSN: 3030-6728
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B. Product Page

Based on figure 5 below is the product page. On this page, users can view a list of products available in the system. The products are arranged in order from the highest to the lowest rating. Users can search for specific products using the search bar. Additionally, users can click on a selected product to access detailed information, including category, brand, price, additional details, and nutrition facts. This facilitates user decision-making based on their needs and preferences.

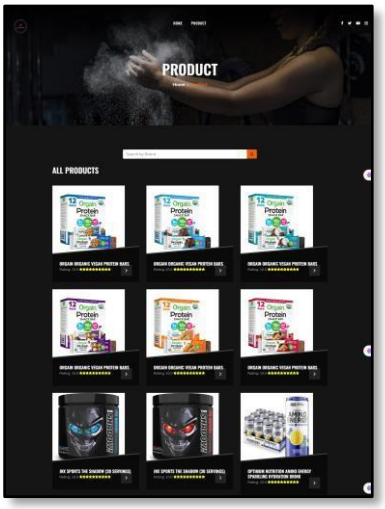

Figure 5: Athlete Nutripal Product page

C. Recommendation Page

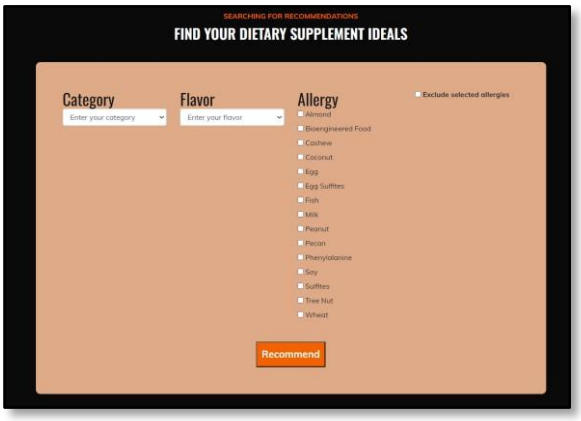

Figure 6: Athlete Nutripal Recommendation form

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Progress in Computer and Mathematics Journal (PCMJ)
volume 1 [October, 2024]
e-ISSN: 3030-6728
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Based on diagram 6 above, it illustrates a recommendation form. If users want to receive recommendations based on their preferences, users need to select the category, flavour, and allergies. Once users have chosen their desired category, the flavour dropdown button will only display flavour options available for that category. After choosing the desired category, users must click the "Recommend" button, which will redirect them to the recommendation page. In this recommendation page, it will display products selected based on the preferences that the user has chosen. Based on diagram 7 below, it is the generated recommendation page to facilitate users in choosing the desired products.

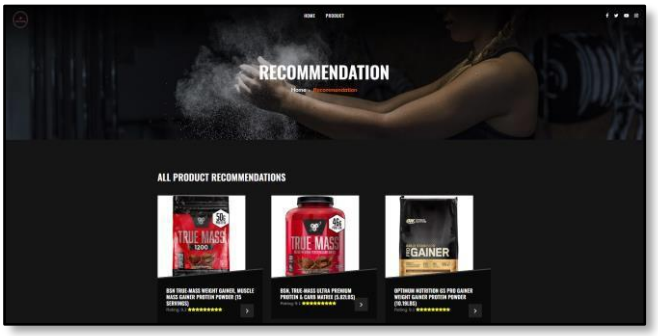

Figure 7: Athlete Nutripal Recommendation page

D. Favourite Page

In the diagram figure 8 below, it represents the favourite page. After users receive recommended products based on their preferences, users can add the selected product to their favourite pages. Users simply need to click the "Add to Favourite" button located in the product details. The favourites page function facilitates users in tracking products selected according to their preferences without the need to search for them again in the list of products. This provides users with a more efficient experience, ensuring that favoured products are easily accessible.

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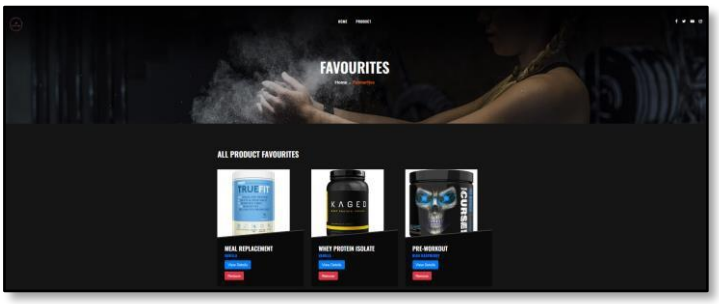

Figure 8: Athlete Nutripal Favourite page

E. Rating Page

Based on the diagram figure 9 below, it shows the rating page where users can provide ratings for the products they have used. Users need to fill in details about the product they have used, select a rating from the dropdown menu, and have the option to provide comments about the product. After users have filled in all the information, they need to press the "Submit" button to submit their feedback. The rating page function allows users to share detailed insights and evaluations of their experience with the product, providing benefits to other users in making decisions about the product.

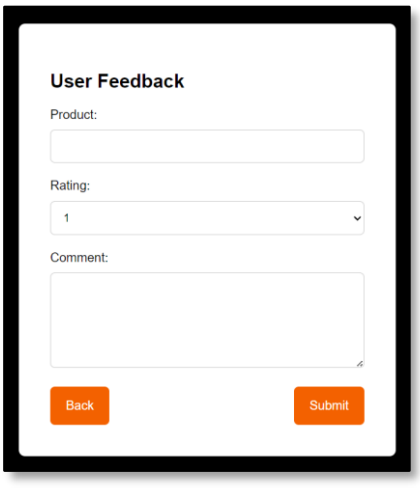

Figure 9: Athlete Nutripal Rating page

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Table 1: List of Functionality Test Cases

Test Case Name	Expected Result	Remark
User Register	The user can successfully register in the system.	Passed
User Login	The user can successfully log in to the system.	Passed
Product	Users can successfully view a list of products in the system.	Passed
View Product Detail	Users can successfully view detailed product information.	Passed
View Product Recommendation	Users can successfully view product recommendations.	Passed
Add to Favorite	Users should be able to successfully add a product to their favorites.	Passed
Remove	Users should be able to successfully remove a product.	Passed
Rate Product	Users can successfully rate a product in the system.	Passed
Rate Submit	Users can successfully submit ratings.	Passed
User Profile	Users can successfully view their profile information.	Passed
Edit Profile	Users should be able to successfully edit their profile, and the changes made should be accurately reflected in the system.	Passed
Logout	Users can successfully log out from the system.	Passed

In the project's assessment, feedback from the tester regarding each test case is provided, encompassing errors encountered during testing, interface evaluation, database performance, and development considerations. Employing the black box testing methodology, the tester evaluated the system based solely on its interface, without inspecting the underlying code, ensuring a fair assessment that simulates the user experience. The results indicate a good rating for various interface functionalities, including user register, user login, product, view product detail, adding to favourite, remove, rate product, rate submit, edit profile, and logout. However, the view product recommendation and user profile functionalities received a moderate rating. Functionality testing revealed that all test cases met the expected outcomes, with the tester's comments affirming the success of each test case and highlighting the system's reliability and effectiveness in delivering the intended functionalities.

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Progress in Computing and Mathematics Journal

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