Volume 11 Issue 3 Year 2026 | Page 1064-1074 | ISSN: 2527-9866
Received: ***12-06-2026*** | *Revised:* ***21-07-2026***| *Accepted:* ***20-08-2026***

Low-Sugar Diet Recommendations for Bangrajan Muay Thai Boxing Athletes Using Collaborative Filtering

Ananda Gilang Presetya Ariyanto[1], Prio Handoko[2]
[1, 2] Design Technology Faculty, Informatics, Pembangunan Jaya University
e-mail: Ananda.gilang00@gmail.com[1], Prio.handoko@upj.ac.id[2]
*Correspondence: Ananda.gilang00@gmail.com

Abstract: *Adjusting diet patterns according to nutritional requirements, training intensity and an athlete's physical condition is often a challenge in implementing a healthy diet, particularly one low in sugar foods. This study aims to develop an artificial intelligence (AI)-based recommendation system that can help boxing and muay thai athletes in implementing a more targeted diet programme through food recommendations tailored to their individual behaviours and nutritional needs. The methods used are collaborative filtering with a nutrition scoring approach, athlete preference analysis, and dynamic nutrition planning. The results show that the developed system, namely the Smart Nutrition System, is able to provide recommendations based on similarities among athletes' preferences and nutritional requirements, thus supporting more effective decision-making in managing athlete diet patterns. Furthermore, the Smart Nutrition System also has the potential to evolve into an "athlete intelligence nutrition platform" that supports the implementation of personalised nutrition for combat sports athletes to support athlete performance.*

Keywords*: Artificial Intelligence, Collaborative-Filtering, Low-Sugar Healthy Food, Muaythai-Boxing Athlete, Smart Nutrition System*

1. Introduction

An athlete is someone who regularly carries out physical activity with the aim of achieving out physical activity with the aim of achieving optimal performance and achievements in the field of sport [1]. In this regard, athletes must be physically and mentally healthy. Proper dietary management is crucial, as it plays a crucial role as a source of energy and can restore stamina after training or competition [2]. In the sports of boxing and Muay Thai, weight classes are used to categorize athletes, so athletes are required to strictly maintain their body condition [3]. However, this condition may prompt athletes to engage in inappropriate dietary management, including severe dietary restrictions and consuming high-sugar foods to get instant energy [4].

Stated that energy imbalance due to inapproprite dietary practices (regukating sugar consumption) has an impact on the health and performanced of athletes [5]. It also stated that a balanced dietary can cover energy expenditure in athletes [6]. Therefore, proper dietary regulation is required, particulary in identifying low-sugar food that can meet the energy needs of boxing and Muat Thai athletes. Nevertheless, indufficient knowledge and understanding of balanced nutrition continue to hinder boxing and Muay Thai athletesin making appropriate dietary choices. One method widely used in recommendation system is *collaborative filtering* [7]. This method utilizes data from other users with similar characteristics or preferences to provide recommendations [8].

Several previous studies reported that conten-based filtering recommendation system have higher accuracy when using limited data, while collaborative filtering requires more data [9]. However, the two approaches generate recommendation based on different principles. Only content-based filtering is only based on content according to user behavior. Studies reported that the combination of both *collaborative filtering* and *content-based learning* methods has advantages in hybrid filtering system, particularly for large-scale applications [10].

Some studies reported that the system has successfully provided relevant, promising, and clinically safe food recommendations as a dietary decision support tool, but still requires development of data volume and variety for optimal results [1]. However, the collaborative filtering recommendation system is capable of providing personalized recommendations in providing data related to the nutrition and dietary of athletes, especially boxing and Muay Thai athletes.

However, the use of collaborative fitering is still limited by data sparsity and cold star-problem (lack of new user data) as well as validation from nutritionists [12]. Censequently, the effective integration of athlete-specific data and food recommendation is needed to obtain accurate results according to the needs of boxing and Muay Thai athletes Based on these issues, this study aims to develop a dietry recommendation system for boxing and Muay Thai athletes using a collaborative filatering method. The proposed system is expected to support athletes in selecting healthy, low-sugar, and nutritionally, balanced dietary patterns that meet the specific nutritional needs of boxing and Muay Thai athletes at Bangrajamuaythai Pamulang.

2. Methods

2.1. Research Location

The research was conducted at Bangrajan Muaythai Pamulang

2.2. Method of Collecting Data

The data collection process in this study was conducted in two ways: primary and secondary data. Primary data was collected through surveys and interview with athletes regarding their food preferences, food consumption habits, and understanding of sugar content in foods. Furthermore, preference data (rating) were collected using “yes” or “no” feature, which was then converted and stored as a positive rating value. This historical data represents user interest in certain low-sugar food items.Secondary data collection was obtained from trusted external sources, using the Indonesian food composition table published by the Ministry of Health. The dataset contains comprehensive nutrional information, including calorie, protein, carbohydrate, fat, and sugar content, which serves as the basis for item profiles for food recommendation [13].

2.3. System Design

In this research, the system was designed using a quantitative approach through the artificial intelligence system development method by implementing a collaborative filtering techniques in building a healthy low-sugar food recommendation system for boxing and Muay Thai athletes [14]. The proposed system design consists of several integrated components: data sests, preprocessing, user profiling, and a recommendation engine. The cintegration of these components in a sequential process facilitates the generation of accurate and personalized recommendations, thereby enhancing the overall effectiveness of the recommendation system [5].

2.3.1. Datasets

In evaluating the performance of the recommendation model, two data sets are used as illustared in figure 1.

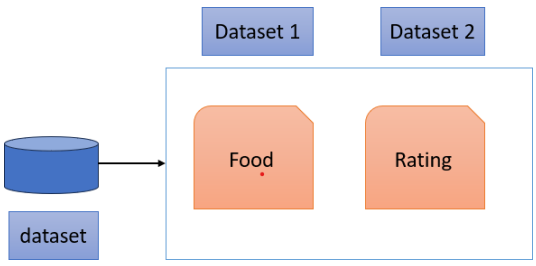


Figure 1. Food Datasets

2.3.2. User Profilling

User profiling is the initial stage in a reommendation system. Its purpose is to display a representation of user characteristic based on preference and user data. Preference data is derived from food history and user ratings of specific foods. The general mathematical formula for representing a user profile can be sees in vector form:

$$Ui = (ri1, ri2, ri3, \ldots\ldots, rin)$$

This vector is the basis for measuring similarity between users in the next stage [16]

2.3.3. Recommendation Engine

The final step is to generate a list of healthy, low sugar food recommendations based on the user similarity calculation. The system will predict user preference for item they've never tried by leveraging ratings from other users with high similarity [17]. The rating prediction can be calculated using the formula:

$$\hat{r}_{u,i} = \frac{\sum_{v \in N(u)} sim(u,v).r_{v,i}}{\sum_{v \in N(u)} |sim(u,v)|}$$

2.4. Collaborative Filtering

2.4.1. Cosine Similarity

In this study, the collaborative filtering algorithm is applied with similariry calculation using cosin similarity. This method can measure the level of similarity between two vectors by calculating the cosine value of the angle formed beetween them. In this case, the vector in question represents user preferences or items [24]. The calculation of cosine similaarity can be expressed as follows:

$$S_c(A,B) = \cos(\theta) = \frac{A \,.\, B}{||A|| \, ||B||} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i} \, \sqrt{\sum_{i=1}^{n} B_i}}$$

2.5. System Evaluation

2.5.1. Period Evaluation

The system evaluation in ths study will be conducted over a period of approximately on month. This time frame was chosen to allow users sufficient time to interact with the system repeatedly, thus obtaining more representative results. In addition, period evaluation can monitor how quickly the interaction system obtains new interaction data and can measure the impact of cold starts because basically the initial system will have difficulty providing accurate recommendations

3. Results and Discussion

3.1. Research Flowchart

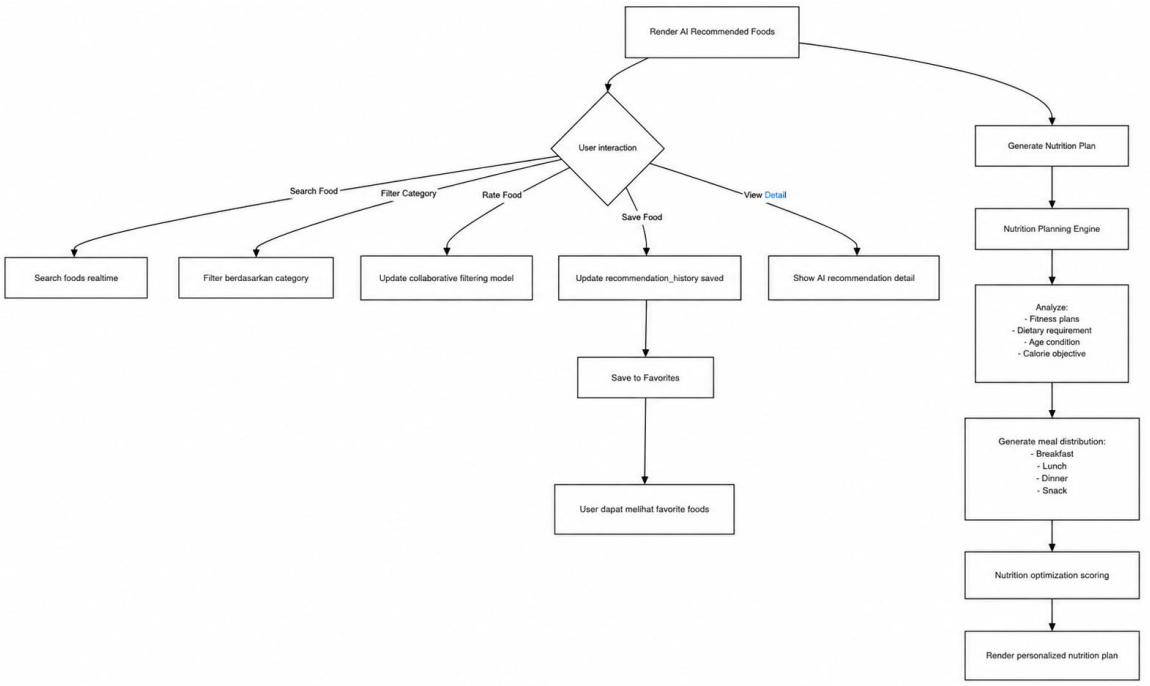


Figure 2. Flowchart

Based on the research process flow, the system begins with user data input, which then goes through a series of validation and data processing processes. Once the data is declared valid, the system performs analysis using several processing and decision-making stages to generate the required information. Throughout the process, several branching points are identified to check for specific condition, allowing the system to automatically determine the next steps. The processed data is the stored in a database and used as the basis for generating output or recommendation. Finally, the system display's the results to the user through a provided interface, allowing the user to utilize the results to the user throught a provide interface, results, information to support more effective and accurate decision-making.

3.2. Athlete Recommendation

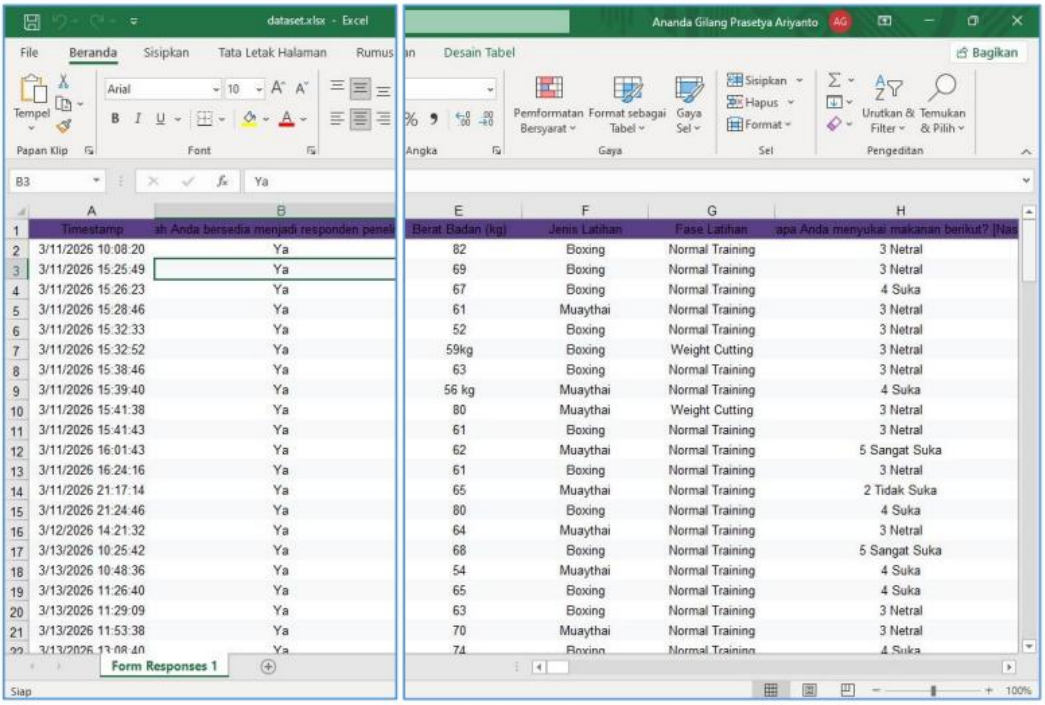
The dataset used in the existing research is a collaborative filtering-based food recommendation system for boxing and Muay Thai athletes. This dataset will be used to build a nutritional recommendation model for athletes.

Figure 3. Dataset Collection Form

Based on the google forms data above, 31 respondents participated in this study. Data collection was conducted using a google forms-based questionnaire. Therefore, the collected data can be presented in the summary responses feature. So, it automatically processes the response results into descriptive statistics and data visualization [18]. Therefore, the use if this feature supports the data processing process systematically, efficiently and accurately.

Figure 4. Dataset Collection Link

From the figure above, it can be seen that before completing the questionnaire, respondents were first given an informed consenr form. This form contains an explanation of the research objectives, which was to develop a food recommendation system for boxing and Muay Thai athletes through an information [11]. Respondents were asked to indicate their willingness to participate in the study by selecting either "yes' or "no". Those who selected 'yes" were considered to have provided informed consent and were directed to complete the questionnaire, whereas respondents who selected "no" did not proceed further. The dataset serves as a source of information that can be used to train recommendation system algorithms through a collaborative filtering approach [22]. Through the analysis of these data, the system was able to identify patterns and relationships between athletes and their nutritional needs and food preferences, enabling the geneartion of personalized dietary recommendation tailored to individual athlete requirements.

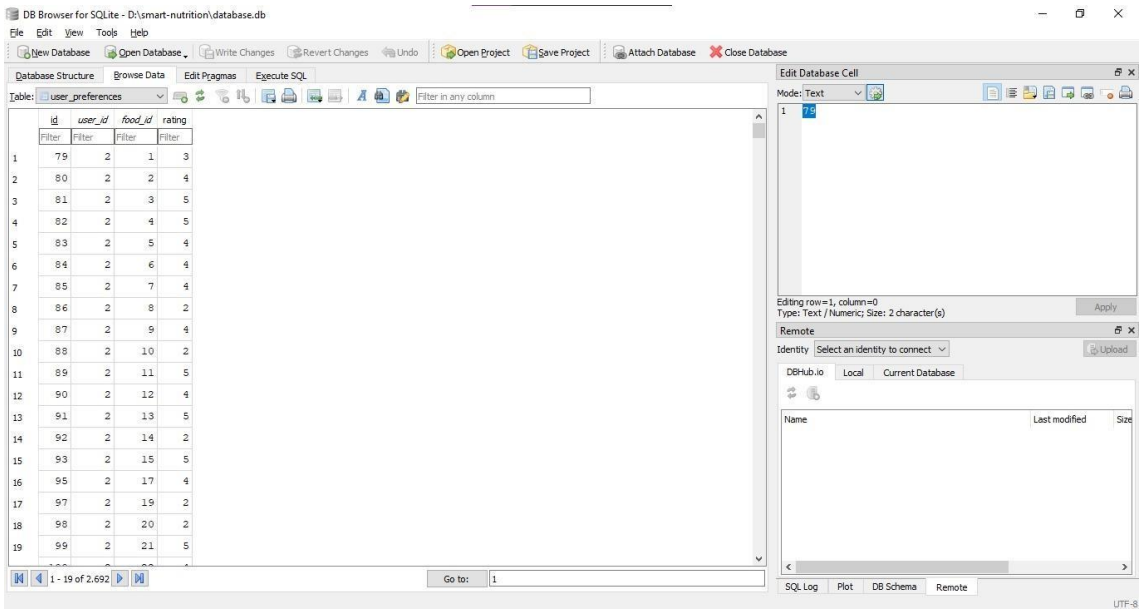


	A	B	E	F	G	H
1	Timestamp	ah Anda bersedia menjadi responden penel	Berat Badan (kg)	Jenis Latihan	Fase Latihan	apa Anda menyukai makanan berikut? [Nas
2	3/11/2026 10:08:20	Ya	82	Boxing	Normal Training	3 Netral
3	3/11/2026 15:25:49	Ya	69	Boxing	Normal Training	3 Netral
4	3/11/2026 15:26:23	Ya	67	Boxing	Normal Training	4 Suka
5	3/11/2026 15:28:46	Ya	61	Muaythai	Normal Training	3 Netral
6	3/11/2026 15:32:33	Ya	52	Boxing	Normal Training	3 Netral
7	3/11/2026 15:32:52	Ya	59kg	Boxing	Weight Cutting	3 Netral
8	3/11/2026 15:38:46	Ya	63	Boxing	Normal Training	3 Netral
9	3/11/2026 15:39:40	Ya	56 kg	Muaythai	Normal Training	4 Suka
10	3/11/2026 15:41:38	Ya	80	Muaythai	Weight Cutting	3 Netral
11	3/11/2026 15:41:43	Ya	61	Boxing	Normal Training	3 Netral
12	3/11/2026 16:01:43	Ya	62	Muaythai	Normal Training	5 Sangat Suka
13	3/11/2026 16:24:16	Ya	61	Boxing	Normal Training	3 Netral
14	3/11/2026 21:17:14	Ya	65	Muaythai	Normal Training	2 Tidak Suka
15	3/11/2026 21:24:46	Ya	80	Boxing	Normal Training	4 Suka
16	3/12/2026 14:21:32	Ya	64	Muaythai	Normal Training	3 Netral
17	3/13/2026 10:25:42	Ya	68	Boxing	Normal Training	5 Sangat Suka
18	3/13/2026 10:48:36	Ya	54	Muaythai	Normal Training	4 Suka
19	3/13/2026 11:26:40	Ya	65	Boxing	Normal Training	4 Suka
20	3/13/2026 11:29:09	Ya	63	Boxing	Normal Training	3 Netral
21	3/13/2026 11:53:38	Ya	70	Muaythai	Normal Training	3 Netral

Figure 5. Dataset from Google Form in Excel Format

Figure 4 shows a dataset from a Google Form questionnaire, exported in Microsoft Excel format for data analysis. The dataset includes respondent willingness, body weight, training phase, type of exercise, food preferences and other data relevant to the development of an athlete nutrition recommendation system [1].

3.3. User Preference



	id	user_id	food_id	rating
1	79	2	1	3
2	80	2	2	4
3	81	2	3	5
4	82	2	4	5
5	83	2	5	4
6	84	2	6	4
7	85	2	7	4
8	86	2	8	2
9	87	2	9	4
10	88	2	10	2
11	89	2	11	5
12	90	2	12	4
13	91	2	13	5
14	92	2	14	2
15	93	2	15	5
16	95	2	17	4
17	97	2	19	2
18	98	2	20	2
19	99	2	21	5

Figure 6. User Preference

Figure 6, shows user preferences, which consist of four main attributes: ID, User ID, Food and rating. The ID serves as the identify for each preference data item stored in the database. The User ID identifies each athlete as a system user. The food attribute represents the type of food the user evaluates or selects, and the rating represents the user's level of preference for the food on a specific scale.

3.4. Recommendation Engine

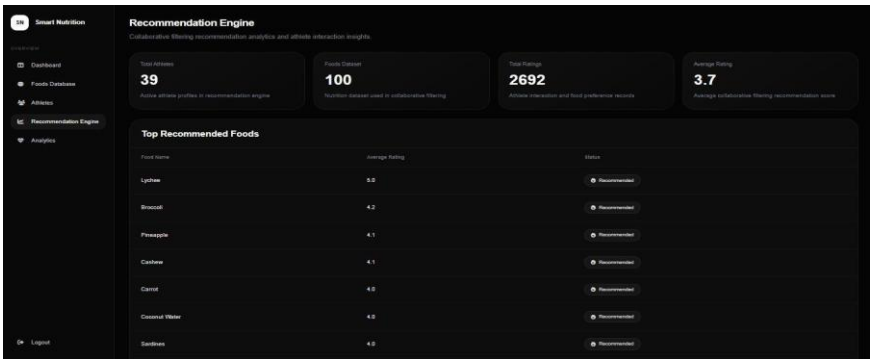


Figure 7. Recommendation Engine

Based on the figure above, the recommendation engine is a key component of a *Smart Nutrition System* (SNS) that provides food recommendation to athletes based on user preference data. Through a similarity calculation process, the system can predict an athlete's preference for similar foods. This approach enables the system to provide more personalized and accurate nutritional recommendations that support the athlete's needs.

3.5. Implementation of Coding

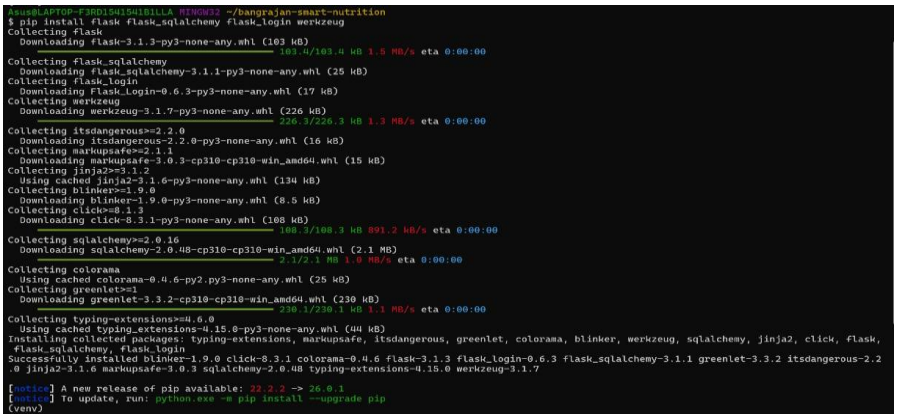


Figure 8. Setup Flask

In this study, flask serves as the primary framework for building an API that will provide recommendations for users [16]. Sqlite is used to mange the database and important data susch as user interaction history, ratings, and food preferences contained in the Smart Nutrition System. This data becomes the primaru data in collaborative filtering [20]. To assist the system in terms of similarity levels, so that each interaction can be linked between users, data libraries such as flask-login are used.

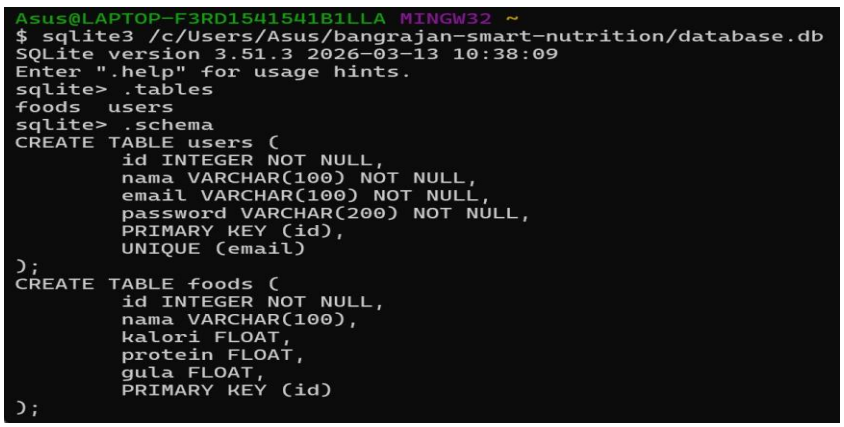
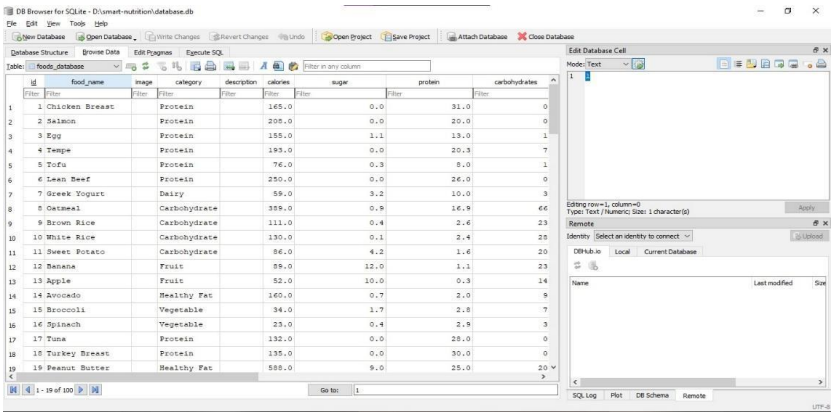


Figure 9. SQLite Database

Figure above, illustrates how a user accesses the database.db file within the bangrajan-smart-nutrition project using Sqlite via the terminal. This indicates that the system is designed to manage both user and food data within the Smart Nutrition System [24].



	id	food_name	image	category	description	calories	sugar	protein	carbohydrates
1	1	Chicken Breast		Protein		165.0	0.0	31.0	0
2	2	Salmon		Protein		208.0	0.0	20.0	0
3	3	Egg		Protein		155.0	1.1	13.0	1
4	4	Tempe		Protein		193.0	0.0	20.3	7
5	5	Tofu		Protein		76.0	0.3	8.0	1
6	6	Lean Beef		Protein		250.0	0.0	26.0	0
7	7	Greek Yogurt		Dairy		59.0	3.2	10.0	3
8	8	Oatmeal		Carbohydrate		389.0	0.9	16.9	66
9	9	Brown Rice		Carbohydrate		111.0	0.4	2.6	23
10	10	White Rice		Carbohydrate		130.0	0.1	2.4	28
11	11	Sweet Potato		Carbohydrate		86.0	4.2	1.6	20
12	12	Banana		Fruit		89.0	12.0	1.1	23
13	13	Apple		Fruit		52.0	10.0	0.3	14
14	14	Avocado		Healthy Fat		160.0	0.7	2.0	9
15	15	Broccoli		Vegetable		34.0	1.7	2.8	7
16	16	Spinach		Vegetable		23.0	0.4	2.9	3
17	17	Tuna		Protein		132.0	0.0	28.0	0
18	18	Turkey Breast		Protein		135.0	0.0	30.0	0
19	19	Peanut Butter		Healthy Fat		588.0	9.0	25.0	20

Figure 10. Food Database

Figure shows a databse stored in SQlite consisting of ID, Food name, image, category, description, calories, sugar, protein and carbohydrates. Each food item is accompanied by nutritional information used to support the recommendation process. With structured and comprehensive data, the system can match user preferences with food characteristics, resulting in more accurate, relevant, and recommendations tailored to the athlete's nutritional needs.

3.6. Implementation of Collaborative Filtering

3.6.1. Login View

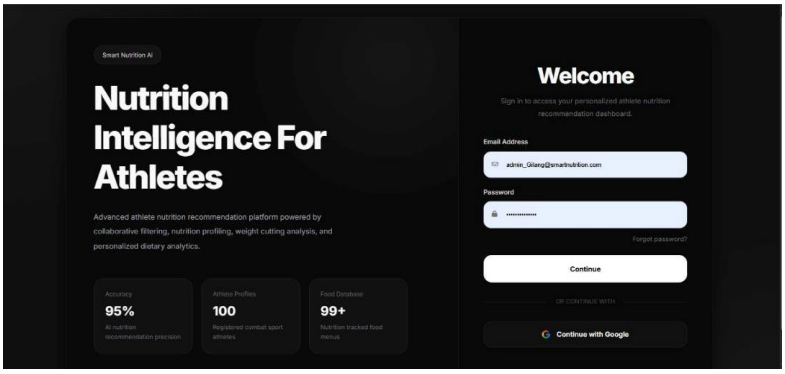


Figure 11. Login View

Figure 11, shows a simple login page view that can be accessed through a local server.

3.6.2. Login with Google

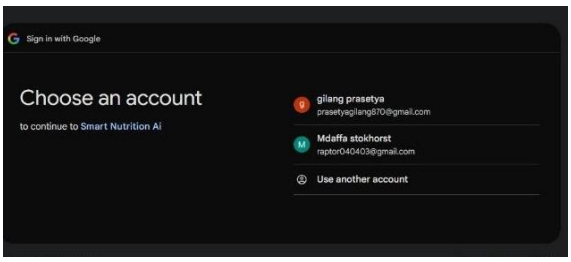


Figure 12. Login with Google

Figure 12, shows the account selection when the user chooses to sign in using google with the registered email and password.

3.6.3. User Profile

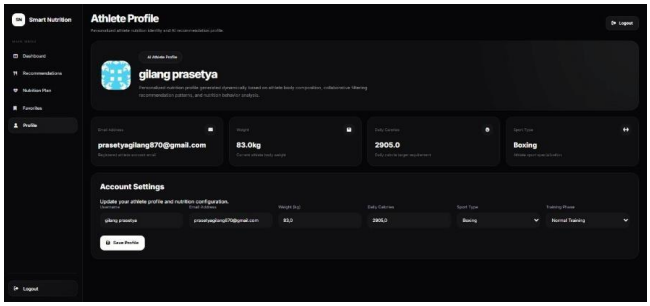


Figure 13. User Profile

Figure 13, shows the athlete profile page on the SNS, which serves as an information center for athlete identity and characteristics used in the nutrition recommendation process. The information displayed includes basic athlete information such as username, email address, weight, calorie needs, and type of exercise.

3.6.4. Dashboard

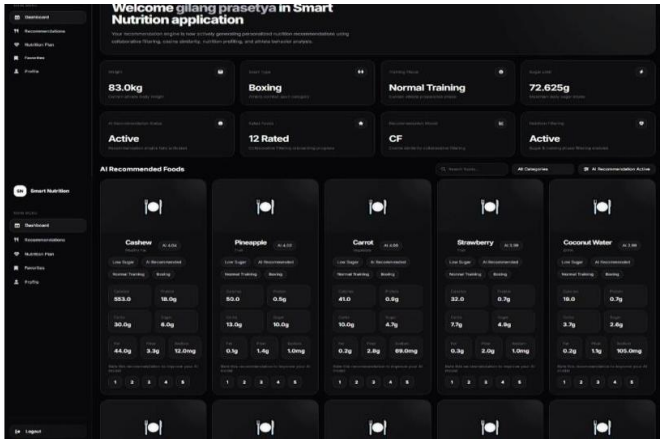


Figure 14. Dashboard

The recommendation system dashboard view, explaining several items such as the food database, number of users, system accuracy level.

3.6.5. Nutrition Plan

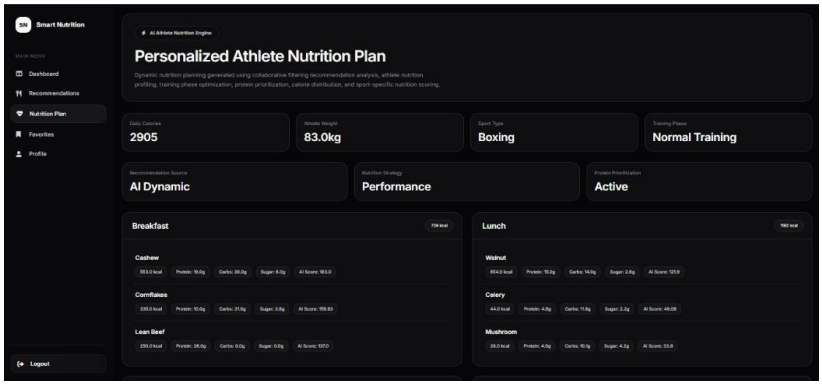


Figure 15. Nutrition Plan

The personalized athlete Nutrtiton plan page is akey feature of the SNS, displaying a daily nutrition plan based on the athlete's profile, energy needs, food preferences and recommendation engine. The system dynamically generates menu recommendations using a collaborative filtering approach that considers user characteristic with similar preference patterns.

3.7. System Evaluation

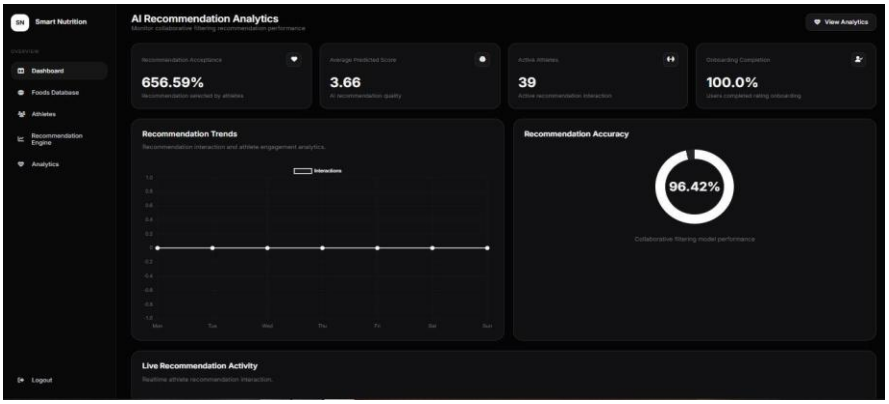


Figure 16. Admin Dashboard

Based on the figure above, the collaborative filtering-based nutrition recommendation system demonstrated excellent performance, with a recommendation accuracy of 96,42% in determining similar recommendation for athletes. Furthermore, the dashboard also visualizes recommendation trens and can be used to assess the system's effectiveness and user participant in utilizing the nutrition recommendations provided [13].

5. Conclusions

The SNS, based on Artificial Intelligence and utilizing the collaborative filtering method, can be developed as a nutrition recommendation system for combat sport athletes, particularly boxing and Muay Thai athletes. Furthermore, the implementation of SQLite facilitates efficient storage and management of user profile, food databases, user preferences and recommendation histories. Thus, SNS also has the potential to be developed into an athlete intelligence nutrition platform that supports nutrition and performance management for athletes. This is because the system can provide food recommendations tailored to each athlete's preference and nutritional needs through cosine similarity calculations.

References

[1] Aline, D., Paix, B. De, Francisco, S., Sousa, S., Vieira, E., & Ferreira, B. (2024). Antibacterial Effect of Cymbopogon citratus Essential Oil against Gram-Positive Bacterial Strains. *Proceedings*, 4–5.

[2] Aljunid, M. F., Manjaiah, D. H., Kazim, M., Ali, W. A., Shetty, A. M., & Qaid, S. (2024). A Collaborative Filtering Recommender Systems : Survey. *Neuorocomputing*.

[3] Ariyus, D., Manongga, D., & Sembiring, I. (2024). *Pengantar Sistem Rekomendasi.*

[4] Barley, O. R., & Chapman, D. W. (2019). The Current State of Weight-Cutting in Combat Sports. *Sports*, 13–17.

[5] Bulínová, V., Wagner, A., & Kumstát, M. (2025). Weight cycling and relative energy de fi ciency in sport syndrome in an elite female muaythai athlete : a case study. *Frontiers in Sports And Active Living*, *May*. https://doi.org/10.3389/fspor.2025.1599131

[6] Chakraborty, R., & Mehta, J. (2025). Collaborative Filtering In Recommender Systems : A Comparative Evaluation. *Journal of International Crisis and Risk Comunication Reserach , 8*, 463–472.

[7] Chen, Yi, Guo, Yandi, Fan, Qiuxu, Zhang, Qinghui, Dong, Y. (2023). Health-Aware Food Recommendation Based on Knowledge Graph and Multi-Task Learning. *Foods*.

[8] Desky, M Azhari, Hamdhana, Defri, Ula, M. (2026). Sistem rekomendasi makanan diet dengan pendekatan Hybrid content-based dan collaborative filtering. *Jurnal Teknologi Dan Sistem Informasi Univrab*, *11*(1), 111–121.

[9] Everett, S. (2025). Optimizing Performance Nutrition for Adolescent Athletes : A Review of Dietary Needs , Risks , and Practical Strategies. *Nutrients*.

[10] Fareed, A., Hassan, S., Brahim, S., & Halim, Z. (2023). Machine Learning with Applications A collaborative filtering recommendation framework utilizing social networks. *Machine Learning with Applications*, *14*(January), 100495. https://doi.org/10.1016/j.mlwa.2023.100495

[11] Fretes, A. V. C. De, Soukotta, A., Chandra, F., Souhoka, S., Wenno, M., Saununu, S. J., Muskitta, F., Watumlawar, E., & Loppies, L. S. (2024). Training On Utilization Of Google Forms As Data Collection Media. *Communnity Development Journal*, *5*(6), 11387–11392.

[12] Harun, J., Yulianto, D., Andrywinata, C., Savero, E., Harun, J., & Yulianto, D. (2025). Product sales recommendation system using item-based collaborative and content-based filtering. *Procedia Computer Science*, *269*, 1643–1653. https://doi.org/10.1016/j.procs.2025.09.107

[13] He, P., Shi, J., Ma, W., & Zheng, X. (2024). Broad collaborative filtering with adjusted cosine similarity by fusing matrix completion. *Applied Soft Computing*, *165*(June 2023), 112075. https://doi.org/10.1016/j.asoc.2024.112075

[14] Hendersen, H., Susanto, W., Fredyan, R., Kurniawan, H. H., & Amien, M. (2024). Movie Recommendation System : A Comparison Based and Collaborative Filtering of Content-Based and Collaborative Filtering. *Procedia Computer Science*, *245*, 860–868. https://doi.org/10.1016/j.procs.2024.10.313

[15] Januszko, P., & Lange, E. (2021). Nutrition , supplementation and weight reduction in combat sports : a review. Public Health, 8(July), 485–498. https://doi.org/10.3934/publichealth.2021038

[16] Khan, H. U., Naz, A., Alarfaj, F. K., & Almusallam, N. (2025). A transformer-based architecture for collaborative filtering modeling in personalized recommender systems. Scie, 1–22.

[17] Khosilova, Z. B. (2022). Nutritional requirements for athletes. International Journal of Innovation in Engineering Research and Technology, 9(4), 142–145.

[18] Mountjoy, M., Sundgot-borgen, J. K., Burke, L. M., Ackerman, K. E., Blauwet, C., Constantini, N., Lebrun, C., Lundy, B., Melin, A. K., Meyer, N. L., Sherman, R. T., Tenforde, A. S., Torstveit, M. K., & Budgett, R. (2018). IOC consensus statement on relative energy deficiency in sport (RED-S): 2018 update. Consensus Statement, 687–697. https://doi.org/10.1136/bjsports-2018-099193

[19] Mutakin, M. D. (2020). Peningkatan Capaian Pengumpulan Tugas Aktif Dan hasil Belajar IPS Dengan Menggunakan Aplikasi google Form. Jurnal Ilmiah WUNY, 2020, 111–124.

[20] Ridwansyah, T., Subartini, B., & Sylviani, S. (2024). Penerapan Metode Content-Based Filtering pada Sistem Rekomendasi. Mathematical Sciences And Applications Journal, 4(2).

[21] Sulistiyono, P., Heriyanto, Y., Priyadi, I., Putri, L. F., & Rilkiyanti, O. (2020). Analisis dan Sinkronisasi Tabel Komposisi Pangan Aplikasi Nutrisurvey Versi Indonesia. Jurnal Nutrisia, 22(1), 39–45. https://doi.org/10.29238/jnutri.v22i1.201

[22] Vivian, D., Ari, I. K., Informatika, P. S., Matematika, F., & Alam, P. (2024). Sistem Rekomendasi Produk pada E-commerce Menggunakan Metode User-Based Collaborative Filtering. Jurnal Nasional Teknologi Informasi Dan Aplikasinya, 2, 753–760.

[23] Waskito, M. R., Rahajoe, A. D., Nurlaili, A. L., & Timur, J. (2024). Implementasi Metode Collaborative Filtering Menggunakan Algoritma Cosine Similarity dan Jaccard Similarity Pada Sistem Ecommerce. Jurnal Informatika Dan Teknik Elektro Terapan, 12(3), 4307–4316.

[24] Yalcin, E., & Bilge, A. (2024). A novel target item - based similarity function in privacy - preserving collaborative filtering. The Journal of Supercomputing, 80(13), 19433–19461. https://doi.org/10.1007/s11227-024-06221-7

[25] Zhang, J., Wang, Z., Liu, W., Liu, X., & Zheng, Q. (2023). A unified approach to designing sequence - based personalized food recommendation systems : tackling dynamic user behaviors. International Journal of Machine Learning and Cybernetics, 14(9), 2903–2912. https://doi.org/10.1007/s13042- 023-01808-7

[26] Zhang, Q., Lu, J., & Jin, Y. (2021). Artificial intelligence in recommender systems. Complex & Intelligent Systems, 7(1), 439–457. https://doi.org/10.1007/s40747-020-00212-w