A Flutter-Based Restaurant Recommendation System in Nusa Dua Using the SAW Method

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Abstract. Culinary tourism plays a significant role in enhancing the travel experience of visitors. In Nusa Dua, Bali, the large influx of both domestic and international tourists has led to an increase in dining establishments, making the process of selecting a restaurant more challenging. This study presents the development of a mobile-based restaurant recommendation system using the Simple Additive Weighting (SAW) method, implemented with the Flutter framework. SAW is chosen for its simplicity, efficiency, and suitability in multi-criteria decision-making, incorporating user-defined factors such as location, price, food category, and rating. Flutter was selected due to its capability to deliver high-performance cross-platform applications with an intuitive user interface. The results of this research include a functional prototype application, a scientific publication, and an intellectual property claim in the form of copyright. The system aims to assist tourists in finding suitable restaurants aligned with their preferences, while also supporting the visibility of local culinary businesses in Nusa Dua.

Keywords: Flutter, Recommendation System, SAW Method

1 Introduction

Tourists visiting a particular region are often engaged in culinary tourism, which includes selecting suitable restaurants. According to the *Kamus Besar Bahasa Indonesia* (KBBI, 2024), a restaurant is defined as a place where meals are served to the public. The process of choosing a restaurant involves various factors, such as the type of cuisine, price, location, rating, ambiance, and personal preferences. A well-informed restaurant choice can enhance the overall culinary experience and, consequently, boost the tourism appeal of a region. In the tourism sector, local culinary culture supports tourism activities, while tourism, in turn, helps promote local culinary identities (Ketut Soma Antara, 2022).

Based on data from Badan Pusat Statistik, Badung Regency ranked first among all regencies in Bali in terms of domestic tourist visits, with a total of 6,745,502 trips in 2024. Additionally, the Indonesia Tourism Development Corporation reported that hotel occupancy in the Nusa Dua area reached 76.65% during the same year. In terms of culinary infrastructure, Badan Pusat Statistik also recorded 4,298 restaurants in

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Badung Regency in 2024, making it the region with the highest number of restaurants in Bali.

This vast number of dining options can pose a challenge for tourists when selecting a restaurant that aligns with their individual preferences. Hence, there is a strong need for a restaurant recommendation system that can assist tourists in identifying suitable dining options based on relevant criteria and personalized choices. A recommendation system is a technology-based solution that provides users with suggestions based on their preferences, historical data, or specific characteristics.

To process user data and generate accurate recommendations, this study adopts the Simple Additive Weighting (SAW) method. SAW is known for its simplicity, speed, and ease of implementation, making it well-suited for multi-criteria decision-making problems. It calculates the weighted sum of each alternative's attribute values to generate a ranking of available options. Compared to other methods, SAW offers computational efficiency, precision in evaluation based on user-defined weights, and objectivity in identifying the optimal choice (Pohan & Sutopo, 2023). These advantages make SAW a suitable method for developing personalized restaurant recommendations for tourists in Nusa Dua.

The mobile application developed in this study uses Flutter, an open-source framework by Google that enables cross-platform development for Android and iOS using a single codebase. Flutter facilitates the creation of high-performance applications with attractive user interfaces and seamless integration with cloud-based databases. These features make Flutter highly appropriate for developing a dynamic, interactive, and user-friendly mobile restaurant recommendation system.

Therefore, this study aims to address the problem of how to design and develop a restaurant recommendation system in the Nusa Dua area using the Simple Additive Weighting (SAW) method in a Flutter-based mobile application, to provide relevant and personalized recommendations based on user preferences.

2 Literature Review

2.1 Related Studies

Ko et al. (2022) classified recommender systems into three main approaches: collaborative filtering, content-based filtering, and hybrid. The hybrid approach often uses weighting techniques to produce more personal and relevant recommendations. However, such approaches generally require complex user interaction data. In this study, the approach used is a multi-criteria-based system with explicit weighting using the SAW method.

Kurniawati et al. (2021) demonstrated that a combination of AHP and SAW could generate recommendations aligned with user preferences. AHP is used to determine the weight of criteria, while SAW calculates the total score of alternatives based on these weights. The addition of new data automatically affects the normalization process, making the method flexible to data dynamics.

Pohan & Sutopo (2023) implemented the SAW method in a food menu recommendation system. In their study, each menu was evaluated based on criteria such as price, taste, and nutritional content, which were processed using normalization and

SAW weighting to generate final recommendations. The results showed that the SAW method could provide accurate recommendations that matched user preferences. This supports the idea that SAW is effective for decision-making contexts involving food choices, similar to this study's focus on restaurant selection.

2.2 Recommender System

A recommender system is a technology-based system designed to help users discover items or options that best match their preferences, needs, or specific characteristics. It works by analyzing historical data, user profiles, or contextual information to suggest relevant items automatically. Ko et al. (2022) categorize recommender systems into several main approaches:

Collaborative Filtering. It recommends items based on behavioral similarities between users.

Content-Based Filtering. It suggests items similar to those previously liked by the user.

Hybrid Approaches. It combines collaborative and content-based filtering to overcome their respective limitations.

Context-Aware Recommendations. It considers time, location, or device context when generating recommendations.

Knowledge-Based Systems. It relies on explicit user preferences and item features.

Group and Deep Learning-Based Recommenders. It is increasingly prevalent in modern AI-powered systems.

However, many of these systems require rich user interaction histories, which is a challenge in scenarios involving new users, such as tourists. In the Recommender Systems Handbook (Ricci et al., 2011), recommender systems are extended within the theoretical scope of decision-making. The core of a recommender system is described as the prediction of utility for an item to a particular user. This process is conceptually aligned with Multi-Criteria Decision Making (MCDM) or Multiple Attribute Decision Making (MADM), which evaluates options based on several weighted attributes or criteria.

2.3 Multiple Attribute Decision Making (MADM)

One of the most widely used MADM approaches in multi-criteria recommender systems is Simple Additive Weighting (SAW). SAW works by summing the normalized and weighted values of each criterion and ranking alternatives based on

their total score. This method enables users—such as tourists—to receive restaurant recommendations tailored to their preferences (e.g., price, distance, rating, ambiance, or cuisine type).

Thus, the recommender system in this study is positioned not only as a preference-based automatic search system but also as a component of a Decision Support System (DSS) using MADM, with SAW as the decision-making engine. Tzeng & Huang (2011) emphasized that SAW is a compensatory method, allowing high values in one criterion to offset lower values in others. This makes SAW suitable for recommender systems that rely on numerical user preferences across multiple factors such as price, location, and rating.

In this study, SAW is selected for its simplicity, efficiency, and transparency in delivering recommendations that can be easily explained to users.

2.4 Simple Additive Weighting (SAW)

The Simple Additive Weighting (SAW) method, also known as weighted sum, is one of the most used approaches in decision-making, especially within the Multi-Attribute Decision Making (MADM) framework (Sunarti, 2020). It is applied in various domains to select the best alternative from several options. The key idea is to assign weights to each alternative based on its performance against all criteria. The calculation steps include:

Normalization of the decision matrix. For benefit criteria like rating, use the formula below:

$$R_{ij} = \frac{X_{ij}}{X_j^{max}} \quad (1)$$

For cost criteria like price and distance, use the formula below:

$$R_{ij} = \frac{X_j^{min}}{X_{ij}} \quad (2)$$

Weighted aggregation. Each normalized value is multiplied by its respective weight and summed:

$$V_i = \sum_{j=i}^{n} w_j . R_{ij} \quad (3)$$

Where:
X_{ij}: the value of alternative i on criterion j
w_j: the normalized score of the weight of criterion j
R_{ij}: the normalized score
V_i: final score of alternative i

2.5 Model-View-View Model (MVVM)

The MVVM architecture consists of three components: Model, View, and ViewModel. The View handles the user interface (UI) and is typically designer-friendly. The Model represents the underlying data. The ViewModel manages the display state, passes data and operations to the view, and handles UI logic and behavior.

According to Lou (2016), MVVM is superior to MVC and MVP in Android development because it supports reactive and modular data handling. Similarly, Zarifis (2017) demonstrated that MVVM promotes clean, organized, and consistent code structures with effective two-way data binding in web development. These MVVM principles apply to mobile app development using Flutter, where the recommendation logic using SAW resides in the ViewModel layer. At the same time, the ViewModel is responsible for displaying the results of the computation.

3 Methodology

The research stages can be described as follows:

3.1 Problem Identification

The steps carried out in the problem identification stage include observing the problem that a fast and preference-based restaurant selection process would be highly beneficial for users when choosing a restaurant.

3.2 Literature Review

The steps conducted in the literature review stage involve collecting previous research documents related to restaurant recommendation systems.

3.3 Data Collection

The data collection method used is web scraping, conducted using a Python application that retrieves data from the website https://serpapi.com. The result of the data collection is 160 restaurant entries located in the Nusa Dua area. The scraped criteria include name, address, coordinates, phone number, website, operating hours, images, rating, price range, category, and additional facilities. After the data is cleaned, the selected criteria for use in the system are: name, category, price, distance, rating, and facilities.

3.4 System Analysis and Design

In this stage, the system is analyzed and designed using UML diagrams, specifically the Use Case Diagram.

Use Case Diagram. The Use Case Diagram above shows an actor named Guest who uses the Restaurant Recommendation System. The actor can view the list of available restaurants and view the restaurant recommendation results. To view the

recommendations, the user must first search for restaurants by entering the desired criteria.

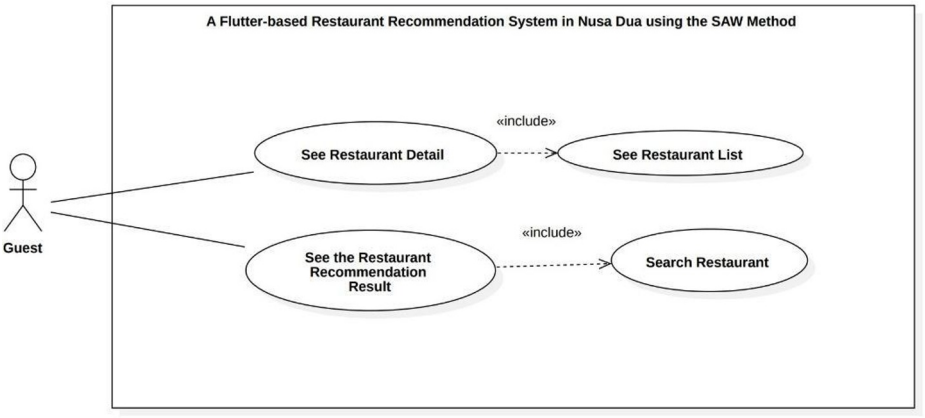

Figure 1. Use Case Diagram

3.5 System Implementation

This stage involves realizing the software design into a working program or unit. Unit testing is carried out to ensure that each unit meets its specifications. In this research, the implementation stage refers to translating the system design into a Flutter-based mobile application.

3.6 System Testing

System testing is performed on each program unit or on the integrated system as a whole to ensure that the software meets the specified requirements. The testing is conducted directly with users to validate the functionality of the system.

4 Result and Discussion

4.1 Result

The interface of the system can be seen below.

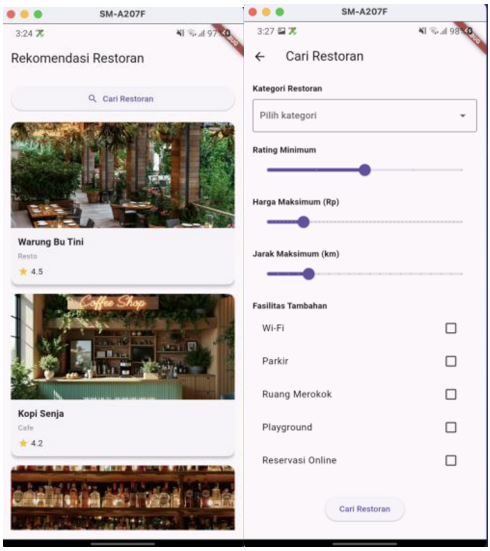

Figure 2. Interface Application

4.2 Blackbox Testing

To ensure that the system functions as expected, black-box testing was conducted. This method focuses on testing the application's functionality without considering its internal code structure. Each feature of the restaurant recommendation system was tested based on the input provided by the user and the expected output generated by the application. The goal of this testing phase is to validate whether the implemented features meet the functional requirements defined during the design phase.

Table 1. Blackbox Testing

No	Functionality	Objective	Expected result	Actual result
1	See Restaurant List	The user can see the restaurant list when they open the app	Pass	Pass
2	Search Restaurant as User Recommendation	The user can search the restaurant from the input criteria that the user uses	Pass	Pass

5 Conclusion

This research has successfully developed a mobile-based restaurant recommendation system for the Nusa Dua area using the Simple Additive Weighting (SAW) method, implemented with the Flutter framework. The system enables users to discover suitable restaurants based on multiple criteria, including category, price, distance, rating, and facilities. The use of the SAW method provides a simple yet effective approach for ranking restaurants according to user preferences.

System implementation in Flutter resulted in an interactive, user-friendly mobile application that functions well on both Android and iOS platforms. Based on black-box testing, all main functionalities—such as displaying restaurant lists and generating personalized recommendations—were validated and performed as expected.

This application is expected to assist tourists in making informed dining choices, thereby improving their culinary experiences and supporting the promotion of local businesses in the Nusa Dua area.

For future work, the recommendation algorithm could be enhanced by incorporating additional multi-criteria decision-making methods such as AHP or TOPSIS, or even integrating real-time data and GPS-based filtering. Furthermore, the dataset can be expanded with user reviews or feedback to improve the accuracy and personalization of recommendations.

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