

# Design a Recommendation System for Ngawi Regency Tourist Attractions Using the Simple Additive Weighting Method

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## Keywords

Ngawi Regency, Simple Additive Weighting, recommendations

**Abstract.** Ngawi Regency is an area in East Java Province which is directly adjacent to Central Java Province. The area of Ngawi Regency has an area of 1,298.58 km<sup>2</sup>. With this area, of course, Ngawi Regency has various types of diverse tourist attractions, such as natural tourism, historical tourism, agro-tourism, water tourism, religious tourism, and many more. So do not be surprised if there are people and even I find it difficult to determine which tourist attractions to visit. This study aims to help determine recommendations for tourist attractions using the calculation of the Simple Additive Weighting (SAW) method. So, tourist attractions will be ranked based on the preference value that has been calculated using the Simple Additive Weighting (SAW) method. The results showed that the system can rank the data of a tourist spot with a set of weighted criteria defined by users and then the tourist attractions are sorted from high to low preference values and display information related to the object so that users can be helped when they want to determine the tourist attractions to be visited and get detailed information related to the tourist attractions.

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## 1. INTRODUCTION

Ngawi Regency is an area bordering Central Java Province and is in the western part of East Java Province. The administration of Ngawi Regency consists of 4 sub-districts from 217 villages and 17 sub-districts. Ngawi Regency has an area of 1,298.58 km<sup>2</sup>, 40 percent of which is rice fields [1] With this area, of course, Ngawi Regency has a variety of interesting tourist attractions. Natural, agro, cultural, religious, water, and culinary tourism are some types of tourism spread in Ngawi Regency. Based on the Badan Pusat Statistik (BPS) of Ngawi Regency, the number of tourists in 2019 reached 937,960, 18 of which were foreign tourists [2]

Many tourist attractions are scattered in the Ngawi Regency area. As a result of consisting of various tourist attractions, people usually have difficulty in finding tourist attractions to visit. The presentation of information about tourist attractions, which is currently only through website media and social media, also still looks incomplete in presenting information and lacks updates. From these problems, the author wants to develop an application that recommends tourist attractions and presents complete information and updates for tourist attractions in Ngawi Regency.

Simple Additive Weighting (SAW) method is a method that will be use in the recommendation system of places or attractions. A method known as Simple Additive Weighting (SAW) can be used to select the best alternative or choice from a variety of options based on specific criteria [3]. It is hoped that using this system will later expose the community in determining the tourist attractions to be visited, as well as obtaining complete and updated information. This study aims to recommend tourist attractions in Ngawi Regency based on preference values with specific criteria values from each alternative (tourist attractions), provide information on test results to users, and display information related to these tourist attractions such as descriptions, entrance ticket prices, operating hours, tourist sites.

The benefits that will result from the research that has done, it can be used to assist users in determining tourist attractions to visit if they find it difficult to make choices, users know the information of existing tourist attractions. It is hoped that this research can increase tourism interest in the community and if many visit, it can improve the economy in Ngawi Regency.

### Theoretical Foundation

#### Ngawi Regency Tourism Objects

According to [4], a place or state of natural environment that has the potential for tourism resources and is built and developed so that it functions both as a tourist destination and as a tourist

attraction. According to [5], a group or related activity capable of attracting tourists to visit a particular location is known as a tourist attraction. In addition, [5] explains that the attraction is its foundation. Without tourist attractions in an area, tourism will be difficult to develop. So, a tourist attraction is an interesting place to visit because it is a pon-tie of tourism and has its own charm in relation to the surrounding environment.

East Java Province is home to Ngawi Regency. The area has an area of 1,298.58 km<sup>2</sup>, 506.6 km<sup>2</sup> of which are rice fields. Topographically, Ngawi Regency is located at 7°21'-7°31' south latitude and 110°10'-111°40' east longitude. There are 217 villages in Ngawi Regency, with 4 sub-districts and 17 sub-districts. Ngawi Regency is bordered to the north by Grobogan Regency, Blora Regency, and Bojonegoro Regency, to the east by Madiun Regency, to the south by Magetan Regency, to the west by Karanganyar Regency, and to the west by Sragen Regency (Central Java Province) [1].

There are many interesting tourist attractions in Ngawi Regency itself. The Ngawi Regency area has various types of tourism, including culinary tourism, agro tourism, cultural tourism, historical tourism, water tourism, religious tourism, and natural tourism. Regarding the many types of tourism, Ngawi Regency has tourism to drive the economy and empower the community. Tourists in Ngawi Regency include many, amounting to 937,960 in 2019 [2].

### Simple Additive Weighting (SAW)

Weighted addition is the common name for the Simple Additive Weighting (SAW) method [6]. The Simple Additive Weighting (SAW) method derives the weighted sum of performance rating values for each option or alternative for all attributes. The process of normalization (x) to a scale that can be compared with all existing ratings is required for the Simple Additive Weighting (SAW) method [7] [8]. Decision makers should assign a weighting value to each attribute when using the Simple Additive Weighting (SAW) method. The sum of all rank multiplication results and the weight of each attribute determines the alternate total score. Previous matrix normalization processes have been used to assess each attribute.

Given equation (1):

$$r_{ij} = \begin{cases} \frac{X_{ij}}{\text{Max } X_{ij}} & \text{If } j \text{ is the benefit attribute} \\ \frac{X_{ij}}{\text{Min } X_{ij}} & \text{If } j \text{ is the cost attribute} \end{cases}$$

Where  $r_{ij}$  is the normalized rank of the  $C_j$  attribute for alternative  $A_i$ ;  $i$  is equal to 1,2,...,  $m$ , and  $j$  is equal to 1,2,...,  $n$  [9]. The value of  $n$  preferences of all alternatives ( $V_i$ ) is then given equation (2):

$$V_i = \sum_{j=1}^n w_j r_{ij}$$

With caption:

- $V_i$  = preference value
- $w_j$  = ranking weights
- $r_{ij}$  = normalized performance rating

[10] The steps in implementing the Simple Additive Weighting (SAW) method are as follows:

- 1) Determine the criteria for which guidelines will be made in making decisions (C).
- 2) Determine how much weight each option or alternative has against all criteria.
- 3) After creating a decision matrix based on criterion (C), normalize the matrix using equations that have been adjusted to the type of attribute so that a normalized matrix R is obtained.
- 4) The ranking process involves combining the weight vector and the multiplication of the normalized matrix R in such a way that the largest value is chosen as the best alternative, which is the final result.

Because it is based on the weight of predetermined criteria and preferences, the Simple Additive Weighting (SAW) method is easier to use and makes more informed decisions.

### Unified Modelling Language (UML)





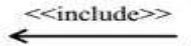

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The industry standard for designing, designing, and visualizing software systems is the Unified Modeling Language (UML) [11]. The standard for modeling systems is also Unified Modeling Language (UML) [12]. Some types of diagrams defined by UML include:

1) Use Case Diagram

The desired functionality of a system is an illustration of a Use case diagram. Actors with the system are an overview of use case diagrams. Use case diagrams place more emphasis on "what" is done, not "how" [13]. Examples of work from use case diagrams, such as logging into the system, registering to the system, checking out, and so on. The following are the symbols in the Use Case Diagram in Table 1.


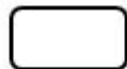
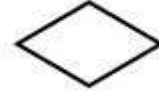



**Table 1 - Use Case Diagram Symbol**

Symbol	Information
	Actor: As a form of role of people, other systems, or means of communication with use cases
	Use Case: Form of abstraction and interaction between actors and systems
	Association: Liaison between actors with use cases
	Generalization: specialization of actors to be able to join use cases
	Indicates that use case functionality differs from other cases
	Indicates a use case is in addition to functionality from another use case if conditions are met.

2) Activity Diagram

The initial flow of the system, the decisions made, and the way the system designed were closed are all described in detail in the activity diagram. Activity diagram describe the process when the system is running [14]. Here are the symbols in the Activity Diagram in Table 2.

**Table 2 - Activity Diagram Symbol**








Symbol	Information
	Initial state: An activity chart has an initial status of the activity
	Activity: The activity performed by a system, usually preceded by a verb
	Decision / Branching: There is a choice of more than one activity
	Join/Merge: Merge more than one activity into one.
	End state: An activity chart has an activity end state
	Swimlane: Separating business organizations that are each responsible for operations

3) Class Diagram

Class diagrams show how classes, packages, and objects are structured and described, as well as how they are all connected to each other through things like association, inheritance, aggregation,

and so on [15]. Classes have three main values: name, attribute, and method. Attributes and methods have one of several properties, including public, private, and protected. Here are the symbols in the Class Diagram in Table 3.

**Table 3 - Class Diagram Symbol**

Symbol	Information
	Generalization: The behavior and data structure of parent and child objects, shared with each other in object relationships.
	Nary Association: Attempts to avoid associating more than two objects
	Class: The set of objects that share the same attributes and operations
	Collaboration: Description of the sequence of actions displayed by the system and producing measurable results for the actor
	Realization: Operations performed by objects
	Depedency: Dependent elements and non-independent elements will be affected by the change relationship that occurs in the independent element.
	Association: Linking objects to each other

## 2. METHOD

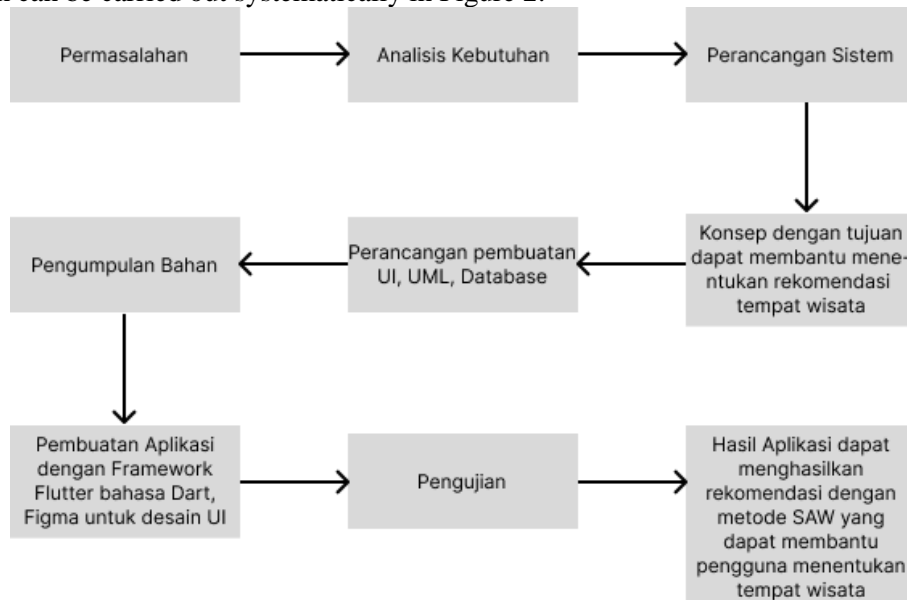
The data collection process was obtained by downloading data from the BPS Ngawi Regency website and other online sources such as Google Maps related to the tour to retrieve rating scores as well as from social media related tourism sites. Research data is information collected for use in making a system as a form of true, precise, and factual information. The data criteria used, including the rating value of a place from Google Maps, the price of entrance tickets to objects or tourist sites, and the assessment of facilities and infrastructure related to objects. The data source comes from the object or location of the tourist spot itself. Data also comes from the website of the Badan Pusat Statistik (BPS) for Tourism of Ngawi Regency. Data is contained in reviews and ratings on Google Maps.

Data collection of tourist attractions in Ngawi Regency can be through the website of the Badan Pusat Statistik (BPS) of Ngawi Regency. The BPS provides various information related to tourism in Ngawi Regency. The rating value is taken through Google Maps according to the name of the tourist spot. Reviews via Google Maps related to converted places and personal observations looking at the completeness and feasibility of facilities as an assessment of facilities and infrastructure. From the collection of these data will be the criteria that will be used in the calculation of Simple Additive Weighting (SAW). These criteria are rating criteria (benefit criteria), entrance ticket price criteria (cost criteria), and infrastructure criteria (benefit criteria). An example of the data to be used in Figure 1.

Data Nilai Masing-Masing Kriteria Alternatif				
No	Nama Tempat	Rating	Harga Tiket Masuk	Sarana Prasarana
1.	Air Terjun Pengantin	4,3	6000	3
2.	Air Terjun Srambang Park	4,4	20000	5
3.	Benteng Pendem Van Den Bosch	4,4	5000	5
4.	Kebun Teh Jamus	4,4	15000	4
5.	Kolam Renang Banyu Redjo Park	4,1	10000	4
6.	Museum Trinil	4,3	5000	2
7.	Palereman Alas Ketonggo Srigati	4,6	5000	2
8.	Selondo	4,3	5000	4
9.	Taman Wisata Tawun	4,2	10000	3
10.	Waduk Pondok	4,2	2000	3
<b>Keterangan Sarana Prasarana</b>				
1 = Sangat Buruk				
2 = Buruk				
3 = Cukup				
4 = Bagus				
5 = Sangat Bagus				

**Figure 1 - Sample Data Used**

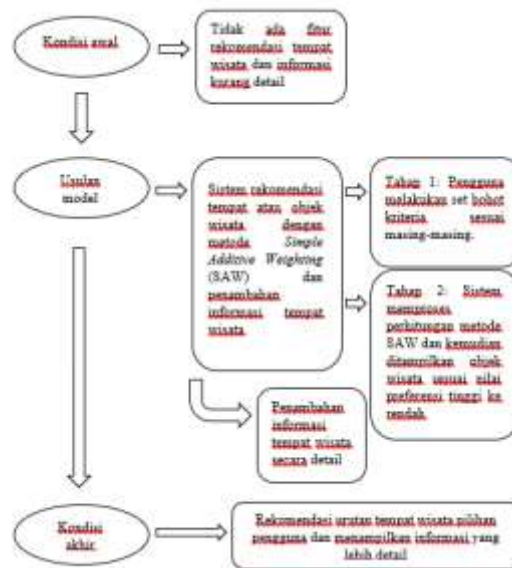
The following are the stages of research that contain steps related to the research carried out so that research can be carried out systematically in Figure 2.



**Figure 2 - Stage of Research**

### System Framework and Design Proposed System Framework

The following is an analysis or proposed design framework related to the research can be seen in Figure 3.



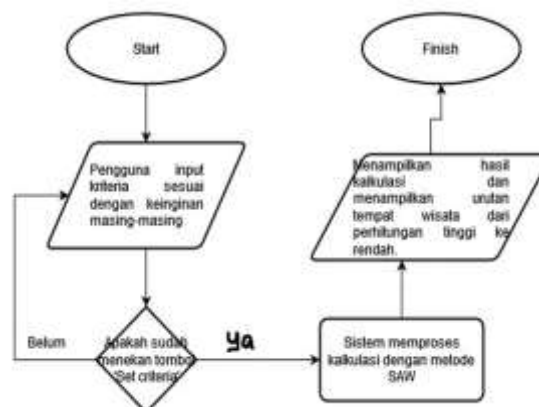
**Figure 3 - Research Framework**

The initial condition illustrates that the system does not have a tourist spot recommendation feature and information about tourist attractions is incomplete. For the proposed model, the addition of a tourist spot recommendation system using the Simple Additive Weighting (SAW) method and the addition of tourist spot information. In the first stage, the user sets the weight of the criteria according to the user. Then, the system will process the calculation using the SAW method and will display the order of tourist attractions according to the preference value from highest to lowest. Adding information also needs to be done so that users can find out detailed tourist information.

The final condition displays the order of tourist attractions based on the calculation of the Simple Additive Weighting (SAW) method with a set of criteria from the user itself and displays complete tourist spot information.

### System Design

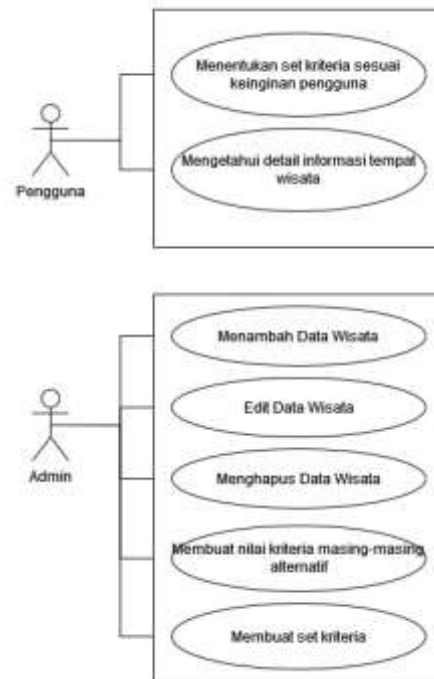
#### 1) Flowchart



**Figure 4 - Flowchart System**

Figure 4 is a flowchart of the system for research. Starting from the start, the user inputs the criteria according to the user's wishes. If the "Set criteria" button is pressed, the system will process the calculation using the Simple Additive Weighting method. Then it will display the calculation results and sort tourist attractions with the highest preference value to the lowest.

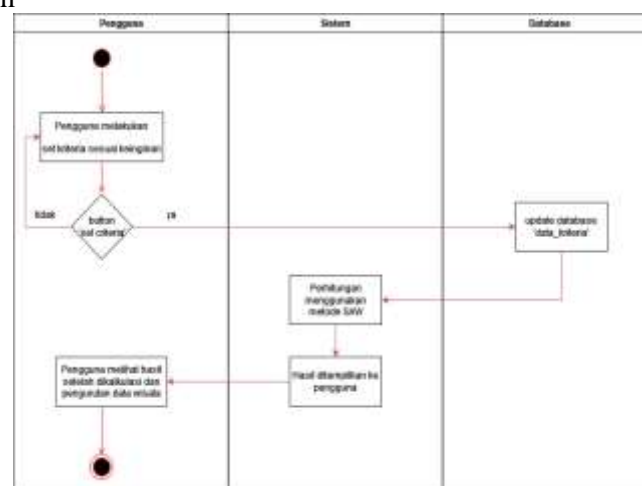
## 2) Use Case Diagram



**Figure 5 - Use Case Diagram System**

As seen in Figure 5, there are two entities, namely user and admin. For entities, users can input the set of criteria as desired and find out information related to tourist attractions using the mobile version. Unlike admins who can Create, Read, Update, and Delete (CRUD) tourist attraction data, create alter-native values for each criterion and add a set of criteria via the website.

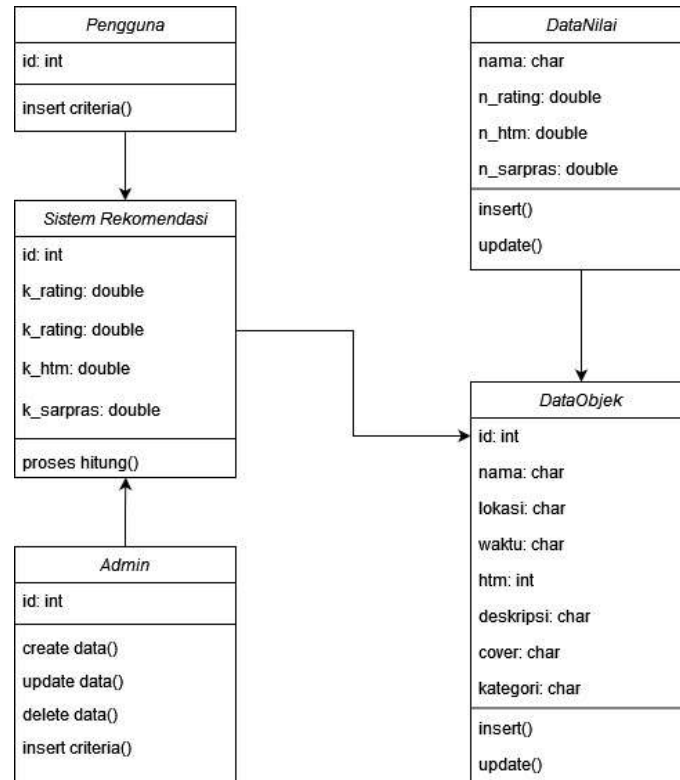
## 3) Activity Diagram



**Figure 6 - Activity Diagram User**

The activity diagram in Figure 6 shows the processes performed from each user, system, and database.

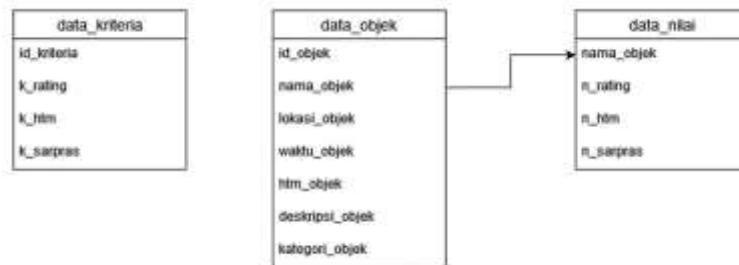
4) Class Diagram



**Figure 7 - Class Diagram Sistem**

Figure 7 shows the relationships between classes that occur.

5) Database Design



**Figure 8 - Database Design**

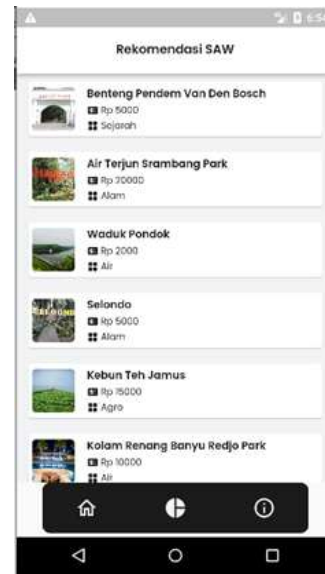
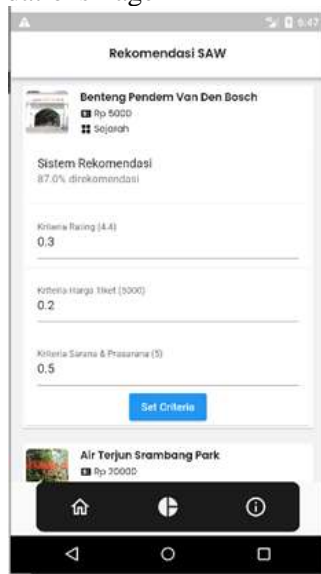
Figure 8 is the database design to be used in this system. The first table "data\_objek" contains information on tourist attractions. The "data\_nilai" table contains the value of each criterion of each alternative or tourist spot. Finally, there is a "data\_kriteria" table to hold the weight of each criteria inputted by the user.

### 3. RESULTS AND DISCUSSION

#### Implementation

This system is created using the Flutter framework with the Dart programming language. The following are the research implementation feeds that have been designed:

1) Recommendations Page



**Figure 9** - Display of Results and Sets of Criteria by User **Figure 10** - Recommendations View

The recommendation page displays the results of the fortune with the Simple Additive Weighting (SAW) method when the travel data is pressed by the user. When the data is pressed, the results will appear and can set criteria from the page as well to change the weight of the criteria according to the user's wishes. The travel data is displayed from data that has high to low results. Here is an implementation of Simple Additive Weighting source code using Flutter framework with the Dart programming language shown in Figure 11 and Figure 12.

```

41  class RecommendationController {
42    Future<List<RecommendationModel>> getRecommendationList() async {
43      try {
44        var url = Uri.parse('${Variables.urlLocal}/data/recommendasi.php');
45        final response = await http.get(url, headers: {'Content-Type': 'application/json'});
46        final criteria = CriteriaController();
47        List<CriteriaModel> criteriaModel = await criteria.getCriteriaList();
48
49        // Step 1: Definisikan bobot
50        double weightSerpas = double.parse(criteriaModel[0].serpas);
51        double weightRata = double.parse(criteriaModel[0].rata);
52        double weightKeting = double.parse(criteriaModel[0].keting);
53
54        // Step 2: Normalisasi nilai
55        List<RecommendationModel> arr = [];
56        List<double> data = jsonDecode(response.body);
57        for (var i = 0; i < data.length; i++) {
58          arr.add(RecommendationModel.fromJson(data[i]));
59        }
60
61        // Step 3: Hitung nilai rata-rata, minimal harga tiket
62        double maxSerpas = arr
63          .map((e) => double.parse(e.serpas ?? '0'))
64          .reduce((value, element) => value > element ? value : element);
65        double minRata = arr
66          .map((e) => double.parse(e.rata ?? '0'))
67          .reduce((value, element) => value < element ? value : element);
68        double maxKeting = arr
69          .map((e) => double.parse(e.keting ?? '0'))
70          .reduce((value, element) => value > element ? value : element);
71
72        // Normalisasi masing-masing kriteria
73        for (var alternative in arr) {
74          double normalizedSerpas =
75            double.parse(alternative.serpas ?? '0') / maxSerpas;
76          double normalizedRata = minRata / double.parse(alternative.rata ?? '0');
77          double normalizedKeting =
78            double.parse(alternative.keting ?? '0') / maxKeting;

```

**Figure 11** - SAW Calculation Source Code part 1

```

79          alternative.normalizedSerpas = normalizedSerpas;
80          alternative.normalizedRata = normalizedRata;
81          alternative.normalizedKeting = normalizedKeting;
82
83          // Step 4: Penggabungan jumlah keseluruhan setiap alternatif
84          for (var alternative in arr) {
85            double weightedSum = alternative.normalizedSerpas * weightSerpas +
86              alternative.normalizedRata * weightRata +
87              alternative.normalizedKeting *
88                weightKeting; // Adjust the otherCriteria value based on your criteria
89
90            alternative.weightedSum =
91              weightedSum; // Add a weightedSum property to the RecommendationModel class to
92
93          // Step 5: Peringkatkan alternatif
94          arr.sort((a, b) => b.weightedSum.compareTo(a.weightedSum));
95
96          // Print the ranking
97          for (var i = 0; i < arr.length; i++) {
98            print('Don't issue "print" in production code. Try using a logging framework.'
99              '\n Rank ${i + 1}: ${arr[i].namaDest, weight Sum: ${arr[i].weightedSum}');
100          }
101
102          return arr;
103        } catch (e) {
104          print('Error printing data: $e'); // Don't issue "print" in production code. Try
105          return [];
106        }

```

**Figure 12** - SAW Calculation Source Code part 2

2) Detail Page



**Figure 13** - Detail View of One of the Tourist Attractions

The details page shows more information related to the attraction. Users can access when pressing the tourist data contained on the main page. Users will see information such as location, operating time, admission price, and description related to the tourist attraction.

**Result**

The results of the study succeeded in calculating the system using the Simple Additive Weighting (SAW) method related to tourist attractions with the weight of criteria inputted by the user, then displaying the order of tourist attractions based on preference values from high to low, so as to help users determine the choice of tourist attractions to visit. This system also displays detailed information related to tourist attractions so that users can find out information about these tourist attractions.

The following is an example of a comparison of the fortunes of the Simple Additive Weighting (SAW) method using manual methods through Microsoft Excel and programs that have been created with examples of each criterion weight, namely rating criteria = 0.4 / Entrance Ticket Price criteria (HTM) = 0.3 / sarpras criteria = 0.3:

1) Manual Calculation Results

NO	NAMA OBJEK	RATING	HTM	SARPRAS	NORMALISASI		
					RATING	HTM	SARPRAS
1	Air Terjun Pengantin	4,3	6000	3	0,934783	0,333333	0,6
2	Air Terjun Srambang Park	4,4	20000	5	0,956522	0,1	1
3	Benteng Pendem Van Den Bosch	4,4	5000	5	0,956522	0,4	1
4	Kebun Teh Jamus	4,4	15000	4	0,956522	0,133333	0,8
5	Kolam Renang Banyu Redjo Park	4,1	10000	4	0,891304	0,2	0,8
6	Museum Triniil	4,3	5000	2	0,934783	0,4	0,4
7	Palereman Alas Ketonggo Srigati	4,6	5000	2	1	0,4	0,4
8	Selondo	4,3	5000	4	0,934783	0,4	0,8
9	Taman Wisata Tawun	4,2	10000	3	0,913043	0,2	0,6
10	Waduk Pondok	4,2	2000	3	0,913043	1	0,6
		4,6	2000	5			
		MAX	MIN	MAX			
BOBOT MASING-MASING KRITERIA		0,4	0,3	0,3			
HASIL NILAI PREFERENSI							
NO	NAMA OBJEK	PREFERENSI					
1	Air Terjun Pengantin	0,65391304					
2	Air Terjun Srambang Park	0,7126087					
3	Benteng Pendem Van Den Bosch	0,8026087					
4	Kebun Teh Jamus	0,6626087					
5	Kolam Renang Banyu Redjo Park	0,65652174					
6	Museum Triniil	0,61391304					
7	Palereman Alas Ketonggo Srigati	0,64					
8	Selondo	0,73391304					
9	Taman Wisata Tawun	0,60521739					
10	Waduk Pondok	0,84521739					

Figure 14 - Manual Calculation Results with Excel

HASIL PERANGKINGAN		
NO	NAMA OBJEK	PREFERENSI
1	Waduk Pondok	0,8452174
2	Benteng Pendem Van Den Bosch	0,8026087
3	Selondo	0,733913
4	Air Terjun Srambang Park	0,7126087
5	Kebun Teh Jamus	0,6626087
6	Kolam Renang Banyu Redjo Park	0,6565217
7	Air Terjun Pengantin	0,653913
8	Palereman Alas Ketonggo Srigati	0,64
9	Museum Triniil	0,613913
10	Taman Wisata Tawun	0,6052174

Figure 15 - Manual Calculation Ranking Results

2) Program Calculation Results

```

TERMINAL - PROBLEMS - OUTPUT - DEBUG CONSOLE - COMMANDS
Launching lib/main.dart on Android SDK built for x86 in debug mode...
✓ Built build/app/outputs/flutter-app-debug.apk
Connecting to VM Service at ws://127.0.0.1:14866/?app=lib/main.dart
I/flutter ( 6766): Row 1: Waduk Pondok, Weighted Sum: 0.8452173913043479
I/flutter ( 6766): Row 2: Benteng Pendem Van Den Bosch, Weighted Sum: 0.802608702174
I/flutter ( 6766): Row 3: Selondo, Weighted Sum: 0.7339130434782609
I/flutter ( 6766): Row 4: Air Terjun Srambang Park, Weighted Sum: 0.712608702174
I/flutter ( 6766): Row 5: Kebun Teh Jamus, Weighted Sum: 0.662608702174
I/flutter ( 6766): Row 6: Kolam Renang Banyu Redjo Park, Weighted Sum: 0.6565217391304348
I/flutter ( 6766): Row 7: Air Terjun Pengantin, Weighted Sum: 0.653913043478261
I/flutter ( 6766): Row 8: Palereman Alas Ketonggo Srigati, Weighted Sum: 0.64
I/flutter ( 6766): Row 9: Museum Triniil, Weighted Sum: 0.6139130434782609
I/flutter ( 6766): Row 10: Taman Wisata Tawun, Weighted Sum: 0.6052173913043479
I/flutter ( 6766): Row 10: Taman Wisata Tawun, Weighted Sum: 0.6052173913043479
Application finished.
Exited [success]
  
```

Figure 16 - Program Calculation and Ranking Results

3) System Testing Table

The following is a system testing table which is an explanation of some system testing processes related to the design of the application which is shown in table 4.

**Table 4 - System Testing Table**

Unit	System Testing	System Reactions	Test Result
Home Page	Display multiple lists of travel data	Display travel data contained in the database	Success
Detail Data	The user clicks one of the records	Displays tourist spot data information according to user choice.	Success
Recommendation	The user sets the weight of the criteria for processing calculations by using the SAW method	Displays the ranking of tourist attractions based on calculations with SAW according to the set of weight criteria from the user	Success

### Discussion

From the results of system testing, manual calculations, and calculations from programs that have been carried out can be described as follows:

- The application can display tourist data and detailed information about tourist attractions in Ngawi Regency.
- Users can set criteria as desired on the recommendation page and the system will perform Simple Additive Weighting method calculations, then display the calculation results from the highest to the lowest preference values.
- Same values for manual calculations and program calculations.

### 4. CONCLUSION

Based on the research that has been made, the system can be used to assist users in determining the location of objects to be visited in the Ngawi Regency area. This is because the system can calculate the rec-recommendation of tourist attractions with the Simple Additive Weighting (SAW) method according to the weight of user-defined criteria. The system can also display the calculation results using the Simple Additive Weighting (SAW) method to the user. The author realizes that there are still many shortcomings and the creation of a system that is far from perfect. Many things must be improved and developed to become a better system. There are various things that are not yet complete to be implemented into this system, such as systems for ticket reservation, integration with Google Maps, and others. The author strives for the system to be developed even better or even be developed by others.

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