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Comparison between SAW and Knowledge based SAW in Recipe Recommendation System

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Abstract. Recipes are used as a reference in processing cooking ingredients to meet personal nutritional needs, considering the ingredients used to make food sold freely that is not necessarily guaranteed in nutritional quality and safe to consume, especially during the pandemic as it is today. So cooking itself becomes a better alternative for the community. With a large number of food recipe options available for various media, the role of a Decision Support System is needed by people who will get food recipe recommendations. Research related to recipe recommendations that have been done are using SAW only and some add experts as a source of knowledge to provide value on the variable time and complexity of cooking recipes. Therefore, in this study, a comparison between the research of recipe recommendations with SAW only and research that added a subsystem of knowledge management derived from experts to support the decision support system of food recipe recommendations was conducted by using correlation testing. The results is there is a strong correlation between knowledge based SAW and user preference to the value of 0.9774. The result is better than SAW only and user preference with the value of 0.7262.

Keyword: *SAW, Chicken, Rank, Value*

1 Introduction

CoronaVirus Disease 2019 (COVID-19) is designated as a global pandemic by WHO, the government made Government Regulation of the Republic of Indonesia Number 21 of 2020 concerning Large-Scale Social Restrictions to Accelerate the Handling of CoronaVirus Disease 2019 (COVID-19) by referring to Law No. 6 of 2018 on Health Quarantine, health quarantine in the form of Large-Scale Social Restrictions to reduce the level of COVID-19 spreading. People are encouraged to carry out a policy of keeping distance from everyone or "physical distancing" and "work from home" to help reduce the spread of COVID-19.

Nutrition is important to maintain the immune system in a COVID-19 era. Foods that are sold freely are not guaranteed about nutritional quality and cleanliness of the raw ingredients, so homemade food becomes a better alternative in the pandemic era. Cooking recipes are important assets in cooking activities which normally recipes are used as a reference in processing raw ingredients to meet individual food nutrition.

Along with the development of technology, millions of health food recipes can be accessed easily in the wider community through various media such as websites, applications, books or magazines, and television. With so many choices of food recipes available in various media, the role of a Decision Support System (DSS) is very crucial for people who are actively cooking using recipes.

DSS has the ability to solve unstructured problems that will help decision makers to improve the quality and efficiency of their decision [1]. DSS in terms of recipe recommendation was initiated in 2014 with many proposed recommendation algorithms such as case-based reasoning [2] and Simple Additive Weighting [3]. Among those algorithms, Simple Additive Weighting (SAW) is proved to be an efficient algorithm in decision making of recipe recommendation.

In 2016, [4] developed the SAW method to improve the recommendation results with a range of centroid (ROC) and add one variable to the criteria. SAW was used to generate recommendations based on user criteria preferences. However, the drawback is all the value for each criterion in the ROC is made based on user personal opinion which actually reduces the quality of the system recommendation results. In our previous study on this subject [5,6], we have developed a recommendation system to solve the recipes recommendation problems with well-known variables in cooking such as duration time variable, the level of the recipe complexity and amount of calories in food as criteria to recommend recipes. Research [5] aims to improve recommendation results by adding the knowledge from experts as references for determining the value of the duration of cooking time variable and the level of complexity of a food recipe. Based on the expert data, the recommendation system was built by using the SAW algorithm.

Research [6] conducted rank consistency testing of SAW algorithms in the food recipe recommendation system. Rank consistency testing is internal, conducted to see whether there is a rank reversal (the first rank is swapped with the last rank) if changes are made to the number of alternative recipes. Rank consistency test results in 100% consistency and no rank reversal (the last recommendation being the first recommendation) for this case.

In the previous studies, there has been no research on the relationship between recommendations built by the system and the choices chosen by the user. Therefore, this study conducted correlation testing between recommendations built by the system and the choice chosen by the user, then conducted a comparison of correlation test results between the research of recipe recommendations with SAW only and research that added a subsystem of knowledge management derived from experts to the food recipe recommendation system.

2 Research Methodology

This research proposes an empirical and practical approach to support users in making their choices online and providing access to high-level recommendations. The challenge of the recommendation system is to provide reasonable, individual, and quality suggestions. This research develops decision support system by using simple additive weighting (SAW) [8] as model management and addition of expert knowledge to determine the value of criteria as in Figure 1. SAW has been used in recommendation systems in [9,10,11,12,13,14] and it has significant recommendation results. The system is running in a mobile application environment and the test has been conducted to know whether SAW algorithm is suitable for recommending recipes that meet user preference.

This research uses 30 data of recipes (referred as 30 alternatives) from [6] and every alternative has 3 values of criteria used to recommend the recipe. The criteria are time to cook, calories [7], and the number of steps used to cook. Table 1 is the data management used in this research.

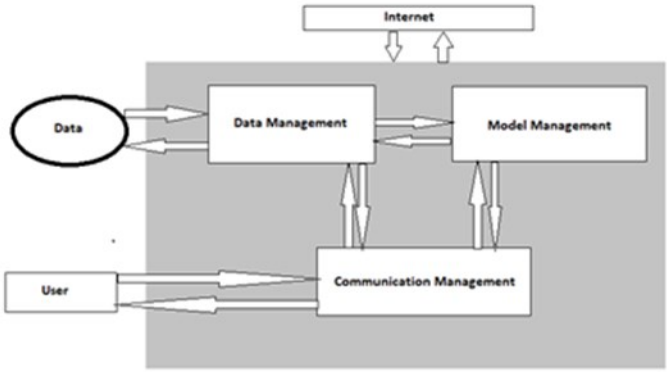

Fig. 1. Research Methodology Diagram

After the data is fixed, the value of time and step in every alternative changes based on the value from expert knowledge. This research improves research [5] in data so it can be the same data with research [6]. Then, there are now the same data for correlation testing.

Table 1 : Data samples with 3 criteria: time, calorie, steps [6]

No	Menu	Time (min)	Calorie (cal)
1	Rawon	45	119
2	Soto	30	312
3	Simple Fried Carp	10	125
...	...	...	...

2.1SAW

SAW was used to recommend recipes based on 3 criterias as mentioned before. SAW recommends a recipe or alternative from the ranking of Vi value (that was calculated from each alternative). Every alternative has a value of Vi and the highest Vi value indicates that the alternative is the best alternative. Problems solving with the SAW method is as follows [8]:

1. Determine the alternative (Ai) that will be processed to get the best alternative.
2. Determine the criteria (Ci) which will be used as a consideration in decision making.
3. Rate each alternative in each criterion.
4. Determine the weight value (W) in the preference or priority level for each number using Equation 1.

$$W = [W1, W2, W3, \dots \dots Wn] \quad (1)$$

5. Create a table of suitability rating for each alternative in each criteria.

6. Create a decision matrix (*X*), the value of *X* is the value of each alternative (*Ai*). Whereas the criteria value (*Ci*) is denoted by *Xij* which represents the criteria value of each alternative. Where *i* = 1, 2, 3.....n and *j* = 1, 2, 3.....n.

$$X = [X11\ X12\ Xij\ \ddots\ \vdots\ X31\ X32\ Xij\ ] \quad (2)$$

7. Calculate normalized performance rating (*Rij*) values from each alternative (*Ai*) in each criteria (*Ci*) to perform matrix normalization process. If criteria is benefit (the higher the value the better for user), *Rij* was calculated as equation 3, vice versa.

$$Rij = Max\frac{Xij}{Xij} \quad (3)$$

8. The results of step seven form a normalization matrix (*R*) as equation 4.

$$R = [R11\ R12\ Rij\ \ddots\ \vdots\ R31\ R32\ Rij\ ] \quad (4)$$

9. After getting the R value, the next is to look for the preference value (*V*) by multiplying the value of the row element in the *R* matrix with the priority of weight (*W*).

$$Vi = \sum_{j=1}^{n} WijRij \quad (5)$$

V value is used for the ranking process. The highest V value indicates that the alternative (Ai) is the best alternative.

2.2 Knowledge-based SAW

This research develops decision support system by using simple additive weighting (SAW) and addition of expert knowledge to determine the value of criteria. The data which was used for knowledge is data from interviews and questionnaires directly to nutritionists and culinary experts from [5]. Knowledge from culinary experts is used to determine the value of each time criteria and level of complexity criteria. Level of complexity counted based on the number of steps. Table 2 and Table 3 show the weight of time variable and level of complexity subsequently.

Table 2 : Knowledge based value for time [5]

Variable: Time (minutes)	Value
Slow (>60)	3
Medium (16-45)	2
Fast (0-15)	1

Table 3 : Knowledge based value for level of complexity [5]

Variable: level of complexity	Value
Complex (number of steps ≥6)	3
Medium (number of steps : 4-5)	2
Simple (number of steps :0-3)	1
...	...

3 Result and Analysis

This system then tested by means of correlation testing. This study uses 2 test scenarios, correlation testing for knowledge-based SAW and SAW only.

3.1 Correlation Testing for SAW

Before we compute the correlation between rank from user and rank generated from SAW, first we compute the vector value generated from SAW and sort it from first until the last ranking of recommendation. After that, we compare it with rank from the user as in Table 4. From Table 4, we can compute the correlation between rank from user and rank generated from SAW is 0.7262, this means there is a positive correlation between rank from user and rank generated from SAW.

Table 4 : Correlation Testing between rank from user and rank generated from SAW

Food Menu	vector value	Rank from SAW	User Rank
Grilled chicken	0.834331337	25	28
Paniki Grilled Chicken	0.834331337	25	28
Tongseng	0.754994742	28	21
Chicken Fried Rice	1.585106383	10	25
Simple and fast fried rice	2.126126126	3	4
Rawon	1.068627451	17	9
Rujak	0.898071625	24	2
Chicken Soto	0.756410256	27	24
Simple Mushroom Saute	2.5	1	1
Sauteed kale	1.632701422	7	3
Sauteed Broccoli Shrimp	2.085106383	5	5
Sauteed Oatmeal With Vegetables	1.602564103	9	14
Energy Pumpkin Soup	1.112449799	16	16
Fat Burning Soup	1.583333333	11	6
Sauteed Long Beans	2.1	4	10
Simple Fried Carp	1.724	6	15
Butter Omelet	2.285714286	2	8
Flour Fried Squid (Fried Squid)	1.233333333	15	18
Pepes	1.358974359	12	7
Uduk rice	1.607692308	8	12
Pecel	0.929223744	21	20
Sweet & spicy meat stew	1.031914894	18	19
Chicken braised in coconut milk	0.738095238	30	27
Chicken noodle	0.899841647	23	26
Chicken Nugget (Chicken Nugget)	1.25	14	17
Vegetable Meatball Chicken Noodles	0.738831615	29	30
Chicken meatballs	1.288888889	13	11

Food Menu	vector value	Rank from SAW	User Rank
Pelas	0.921212121	22	22
Lamongan Beef Soto	0.961187215	19	23
Simple spiced goat curry	0.936654367	20	13
Correlation		**0.7262**	

3.2 Correlation Testing for Knowledge based-SAW

Before we compute the correlation between rank from user and rank generated from SAW, first we compute the vector value generated from SAW and sort it from first until the last rank recommendation. After that, we compare it with the rank from the user. From Table 5, we can compute the correlation between rank from user and rank generated from knowledge-based SAW is 0.9774, this is means there is positive correlation between rank from user and rank generated from KB-SAW and this result is better than SAW only with the value of 0.7262.

Table 5 : Correlation Testing between rank from user and rank generated from SAW

Food Menu	vector value	Rank from KB-SAW	User rank
Grilled chicken	0.834331337	28	28
Paniki Grilled Chicken	0.834331337	28	28
Tongseng	0.754994742	21	21
Chicken Fried Rice	1.585106383	25	25
Simple and fast fried rice	2.126126126	4	4
Rawon	1.068627451	9	9
Rujak	0.898071625	2	2
Chicken Soto	0.756410256	24	24
Simple Mushroom Saute	2.5	1	1
Sauteed kale	1.632701422	3	3
Sauteed Broccoli Shrimp	2.085106383	5	5
Sauteed Oatmeal With Vegetables	1.602564103	14	14
Energy Pumpkin Soup	1.112449799	11	16
Fat Burning Soup	1.583333333	6	6
Sauteed Long Beans	2.1	15	10
Simple Fried Carp	1.724	10	15
Butter Omelet	2.285714286	8	8
Flour Fried Squid (Fried Squid)	1.233333333	18	18
Pepes	1.358974359	7	7
Uduk rice	1.607692308	12	12
Pecel	0.929223744	20	20
Sweet & spicy meat stew	1.031914894	19	19
Chicken braised in coconut milk	0.738095238	26	27
Chicken noodle	0.899841647	27	26
Chicken Nugget (Chicken Nugget)	1.25	17	17
Vegetable Meatball Chicken Noodles	0.738831615	30	30
Chicken meatballs	1.288888889	16	11
Pelas	0.921212121	22	22
Lamongan Beef Soto	0.961187215	23	23
Simple spiced goat curry	0.936654367	13	13
Correlation		**0.9774**	

3.3 Results Analysis

Adding expert knowledge can be a reference for assigning values to time variables and level of complexity. This study makes correlation testing for knowledge-based SAW and SAW only. The result is there was a strong correlation between knowledge -based SAW and user preference to the value of 0.9774. It means that knowledge - based SAW's performance in providing recommendations is close to what users want. The result is better than SAW only with the value of 0.7262.

4 Conclusion

This study uses 2 test scenarios, correlation testing for knowledge-based SAW and SAW only. The result is there was a strong correlation between knowledge based SAW and user preference to the value of 0.9774. The result is better than SAW only with the value of 0.7262

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References

1. Turban, Efraim. Decision support and expert systems: management support systems. Prentice Hall PTR, 1993.
2. Setyahadi, Pradiptya. "Rancang Bangun Aplikasi Resep Masakan Berbasis Mobile Web Dengan Metode Case-Based Reasoning." Yogyakarta: Universitas Islam Negeri Sunan Kalijaga (2014).
3. Salsabella, Amira. "Sistem Pendukung Keputusan Penentuan Resep Masakan Berdasarkan Ketersediaan Bahan Makanan Menggunakan Metode Simple Additive Weighting (SAW) Berbasis Web." Jurnal Sistem dan Teknologi Informasi (JUSTIN)2.3 (2014): 110-117.
4. Santoso, Tino Aprika. “Aplikasi Pencarian Resep Masakan Berbasis Mobile Web Berdasarkan Ketersediaan Bahan dengan Metode Simple Additive Weighting.” Diss. UII, 2016.
5. Nabila; Dewi, Ratih Kartika; Brata, Komang Candra. ”SPK Pemilihan Resep Masakan dan Fitur Berbasis Lokasi”.JPTIIK. 2018.
6. Dewi, Ratih Kartika, Komang Candra Brata, and Nabila Nabila. "Konsistensi Ranking pada Sistem Rekomendasi Resep Masakan dengan Simple Additive Weighting." Jurnal Nasional Teknik Elektro dan Teknologi Informasi (JNTETI) 8.3 (2019): 235-240.
7. The Fatsecret website. (Online), https://www.fatsecret.co.id/.
8. Yoon, K. Paul, and Ching-Lai Hwang. Multiple attribute decision making: an introduction. Vol. 104. Sage publications, 1995.
9. Sahir, Syafrida Hafni, R. Rosmawati, and Kresna Minan. "Simple additive weighting method to determining employee salary increase rate." Int. J. Sci. Res. Sci. Technol 3.8 (2017): 42-48.
10. Adela, Hana, et al. "Selection of dancer member using simple additive weighting." International Journal of Engineering & Technology 7.3 (2018): 1096-1107.

11. Nurmalini, N., and Robbi Rahim. "Study Approach of Simple Additive Weighting For Decision Support System." Int. J. Sci. Res. Sci. Technol 3.3 (2017): 541-544.
12. Setiawan, Nashrudin, et al. "Simple additive weighting as decision support system for determining employees salary." Int. J. Eng. Technol 7.2.14 (2018): 309-313.
13. Pratiwi, Dyah, Juliana Putri Lestari, and D. Agushita. "Decision Support System to Majoring High School Student Using Simple Additive Weighting Method." International Journal of Computer Trends and Technology 10.3 (2014): 153-159.
14. Aminudin, Nur, et al. "Higher education selection using simple additive weighting." International Journal of Engineering and Technology (UAE) 7.2.27 (2018): 211-217.John R. Smith and Shih-Fu Chang. 1997. VisualSEEk: a fully automated content-based image query system. In Proceedings of the fourth ACM international conference on Multimedia (MULTIMEDIA '96). Association for Computing Machinery, New York, NY, USA, 87–98. https://doi.org/10.1145/244130.244151