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SMARTPHONE RECOMMENDATION DECISION SUPPORT SYSTEM USING THE TOPSIS METHOD

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Abstract: Many smartphone brands with various specifications and competitive prices often make consumers confused when deciding which smartphone to buy. There are many choice factors for consumers to buy the right smartphone according to their use, while the choice of smartphone is still considered subjective, so it is not uncommon for the choice of smartphone to be less than optimal. The aim of this research is to recommend the best smartphone based on predetermined usability and price criteria, including gaming needs, content creators and low price using the Technique for Others Preference by Similarity to Ideal Selection (TOPSIS) method. The results of the process of implementing the TOPSIS method can display alternative ranking data from the largest value to the smallest value.

Keywords: Decision Support Systems, Smartphone Recommendations, TOPSIS

1. INTRODUCTION

In the current digital era, smartphones have become one of the primary needs for society. Rapid technological advances mean that the smartphone industry continues to present new innovations with increasingly sophisticated features. However, the diversity of products offered and rapid technological advances make it difficult for consumers to choose the smartphone that best suits their needs and preferences. The decision to purchase a smartphone is a complex process, influenced by various factors such as technical specifications, brand, price, camera quality, battery life, and so on. The public's need for assistance in making purchasing decisions is increasing, especially with the increasing number of product options available on the market.

In today's competitive environment, smartphone vendors compete to provide products with a variety of modern options and features that can pamper consumers. However, this diversity and many choices often make consumers confused in determining which smartphone best suits their needs and preferences. In addition, smartphone selection is often still subjective, with sellers tending to recommend based on the brand that generates the greatest profit for the store, without fully considering consumer needs. As a result, decisions in choosing a smartphone sometimes do not reach the optimal level. Decision Support Systems (DSS) are the right approach to help consumers face this challenge. SPK utilizes data and certain analysis techniques to provide recommendations or help make better decisions.

The technique often used in SPK is TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution). TOPSIS is an effective method for selecting the best alternative from a number of available options by considering certain criteria. Several recent studies in this domain have shown that the integration of artificial intelligence technologies such as machine learning and data mining has strengthened the ability of decision support systems to provide more accurate and personalized recommendations. In addition, the TOPSIS method has been proven effective in the SPK context for various applications, including smartphone selection.

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However, although much research has been carried out in the development of SPK for smartphone selection, there is still room for improvement in system performance and accuracy, especially in the context of increasingly fierce competition and rapid market dynamics. Through this research, we aim to develop a TOPSIS-based Decision Support System (DSS) to help consumers choose the smartphone that best suits their needs and preferences. Thus, it is hoped that this research can make a positive contribution in simplifying the smartphone purchasing decision making process for consumers and help the industry in increasing consumer satisfaction through products that are more in line with market needs.

The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) was introduced by Yoon and Hwang in 1981. This method is a multi-criteria decision making method which has the concept that the selected alternative is the best alternative that has the shortest distance from the positive ideal solution and the longest distance. from a negative ideal solution (Alawiah & Susilowati, 2018). The TOPSIS method has been widely used to solve practical decision-making problems. The advantages of this method lie in the simplicity and ease of understanding the concept, computational efficiency, and the ability to measure the relative performance of decision alternatives in simple mathematical form.

The procedural stages in the TOPSIS method are as follows (Wahyuni, Niska & Hariyanto, 2019):

1. Create a normalized decision matrix using the Euclidean Length of a vector method:
   r_ij = x_ij / √(∑_(i=1)^m 〖x_ij^2〗)
   r_ij is the normalized matrix of each alternative [i] against criteria [j]
   x_ij is a decision matrix that shows the value of an alternative [i] against criteria [j]

2. Create a weighted normalized decision matrix with weights y (y1, y2, ..., yn), then the normalization of the weights of the y matrix is:

$$y = \begin{bmatrix} y11 & y12 \,.. & y_{1j} \\ y21 & y22 \,.. & y_{2j} \\ y_{i1} & y_{i2} \,.. & y_{ij} \end{bmatrix}$$

   for $y_{ij} = w_j r_{ij}$

   w_i is the weight of the jth criterion
   y_ij is an element of the normalized decision matrix

3. Determine the positive ideal solution and the negative ideal solution:
   A+ = (y1+, y2+, ..., yn+)
   A- = (y1-, y2-, ..., yn-)

   Where:
   y_j+ is the maximum value of the weighted normalization value (y_ij) if the jth criterion is a profit attribute, and the minimum value if the jth criterion is a cost attribute.
   y_j- is the minimum value of the weighted normalization value (y_ij) if the jth criterion is a profit attribute, and the maximum value if the jth criterion is a cost attribute.

4. Calculating the distance between the value of each alternative with the positive ideal solution matrix (D^+) and the negative ideal solution matrix (D^-):
   Di+ = √(∑_(i=1)^n (y_i^+ - y_ij)^2);
   i = 1,2,...,m
   Di- = √(∑_(i=1)^n (y_ij - y_i^-)^2);
   i = 1,2,...,m

Di+ is the distance between the alternative and the positive ideal solution (yj+), calculated from the root of the sum of the values of each alternative subtracted from the positive ideal solution, and then squared by two.
Di- is the distance between alternatives and the negative ideal solution (yj-), calculated from the root of the sum of the values of each alternative reduced by the negative ideal solution, and then squared by two.

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5. Determine the preference value for each alternative. The preference value (Vi) shows the closeness of an alternative to the ideal solution:
   Vi = Di- / (Di- + Di+); i = 1,2,...,m

   Where the alternative with a greater Vi value indicates a higher priority.

2. METHOD

The non-participant observation method is used to obtain the necessary data and information, as well as to look for problems faced by users in finding out smartphone specifications and prices that suit their needs and price budget. Through observation, various smartphone specifications with certain criteria and prices will be identified to be used in determining smartphone recommendations. Data regarding these criteria will be supporting data in creating a Smartphone Recommendation Decision Support System using the TOPSIS method. Literature study was carried out by reading and understanding articles, journals, books and previous final assignment reports that were relevant to the problem studied in this research. The literature study aims to deepen knowledge about decision support systems and the TOPSIS method that will be used in this research. In addition, through literature study, information will be collected regarding supporting components to determine specification criteria based on articles and blogs that discuss several recommendations for smartphone choices from each alternative use.

3. RESULT AND DISCUSSION

In TOPSIS there are known names as alternatives, criteria, criteria weights and preference weights which will be applied to the decision support system for selecting Android smartphones.

1. Weighting
   The alternatives used in selecting an Android smartphone are as follows:

Table 1 Alternative

CODE	NAME
A1	Xiaomi 12 Pro
A2	Samsung Galaxy S22 5G
A3	Oppo Reno 8 Pro 5G
A4	Xiaomi Black Shark 4
A5	Asus Zenfone 9
A6	Realmi GT Neo 2 5G
A7	Vivo V23 5G
A8	Xiaomi 12 Lite
A9	Samsung Galaxy A23 5G
A10	Realmi 8 Pro
A11	Samsung Galaxy A32
A12	Vivo Y15S
A13	Infinix Hot 10S

Determination of criteria weights

In the weighting determined each criterion is shown in the following table:

Table 2. Weight of Gaming Smartphone Criteria

NAME CRITERIA	CRITERIA	WEIGHT	CODE	ATTRIBUTE
Gaming	Processor	5	C1	Benefit
Gaming	RAM	5	C2	Benefit

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Gaming	Internal	4	C3	Benefit
Gaming	Camera	2	C4	Benefit
Gaming	Price	1	C5	Cost

Table 3. WEIGHT CRITERIA Smartphone Content Creator

NAME CRITERIA	CRITERIA	WEIGHT	CODE	ATTRIBUTE
Content Creator	Processor	4	C1	Benefit
Content Creator	RAM	4	C2	Benefit
Content Creator	Internal	5	C3	Benefit
Content Creator	Camera	5	C4	Benefit
Content Creator	Price	3	C5	Cost

Table 4. WEIGHT CRITERIA Smartphone Low Price

NAME CRITERIA	CRITERIA	WEIGHT	CODE	ATTRIBUTE
Low Price	Processor	2	C1	Benefit
Low Price	RAM	3	C2	Benefit
Low Price	Internal	3	C3	Benefit
Low Price	Camera	3	C4	Benefit
Low Price	Price	5	C5	Cost

1) Ranking

The following is an explanation of the assessment preference rules from CRITERIA C1, C2, C3, C4, C5, which have been described previously, by giving grades based on general classification using a scale of 1-5.

Table 5. WEIGHT Preference Processor

CRITERIA	TYPE	PREFERENCE
Processor (C1)	Snapdragon series < 5 Snapdragon series >= 5 Snapdragon series >= 6 Snapdragon series >= 7	1 2 3 4

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	Snapdragon series >= 8	5
	Mediatek dimensity < 700	1
	Mediatek dimensity >= 700	2
	Mediatek dimensity >= 800	3
	Mediatek dimensity >= 8000	4
	Mediatek dimensity >= 9000	5
	Mediatek helio < 90	1
	Mediatek helio >= 90	2
	Mediatek helio > 96	3
	-	4
	-	5
	Exynos <= 850	1
	Exynos > 850	2
	Exynos >= 1000	3
	Exynos >= 2000	4
	Exynos >= 2200	5

Table 6. WEIGHT Preference

CRITERIA	TYPE	PREFERENCE
RAM (C2)	< 4 gb	1
	< 6 gb	2
	< 8 gb	3
	8 gb	4
	> 8 gb	5
Internal (C3)	< 32 gb	1
	< 64 gb	2
	< 128 gb	3
	128 gb	4
	256 gb	5
Camera (C4)	< 12 mp	1
	< 20 mp	2
	< 50 mp	3
	< 100 mp	4
	>= 100 mp	5
Price (C5)	< 2.000.000	1
	< 4.000.000	2
	< 6.000.000	3
	< 8.000.000	4
	>= 8.000.000	5

In this process, ranking will be carried out using the TOPSIS method. In this research, several Android smartphone data will be used, consisting of 13 data, in the following table:

Table 7. Smartphone Data

NO	NAME	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE

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1	Xiaomi 12 Pro	Snapdragon 8 gen 1	12 gb	256 gb	50 mp	12.999.000
2	Samsung Galaxy S22 5G	Snapdragon 8 gen 1 5G	8 gb	256 gb	50 mp	10.499.000
3	Oppo Reno 8 Pro 5G	Mediatek Dimensity 8100 5G	12 gb	256 gb	50 mp	9.999.000
4	Xiaomi Black Shark 4	Snapdragon 870	8 gb	128 gb	48 mp	8.599.000
5	Asus Zenfone 9	Snapdragon 8 gen 1	6 gb	128 gb	50 mp	7.999.000
6	Realmi GT Neo 2 5G	Snapdragon 870 5G	12 gb	256 gb	64 mp	6.699.000
7	Vivo V23 5G	Mediatek Dimensity 920 5G	8 gb	128 gb	64 mp	5.999.000
8	Xiaomi 12 Lite	Snapdragon 778 G	8 gb	256 gb	108 mp	4.999.000
9	Samsung Galaxy A23 5G	Snapdragon 695 5G	8 gb	128 gb	50 mp	3.999.000
10	Realmi 8 Pro	Snapdragon 720 G	8 gb	128 gb	108 mp	3.899.000
11	Samsung Galaxy A32	Mediatek Helio G80	6 gb	128 gb	64 mp	2.799.000
12	Vivo Y15S	Mediatek Helio P35	3 gb	64 gb	13 mp	1.899.000
13	Infinix Hot 10S	Mediatek Helio G85	4 gb	64 gb	48 mp	1.499.000

The following is the initial decision matrix:

Table 8. Initial Decision Matrix

ALTERNATIVE	SMARTPHONE	CRITERIA				
		PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A1	Xiaomi 12 Pro	5	5	5	4	5
A2	Samsung Galaxy S22 5G	5	4	5	4	5
A3	Oppo Reno 8 Pro 5G	4	5	5	4	5
A4	Xiaomi Black Shark 4	5	4	4	3	5
A5	Asus Zenfone 9	5	3	4	4	4
A6	Realmi GT Neo 2 5G	5	5	5	4	4
A7	Vivo V23 5G	3	4	4	4	3
A8	Xiaomi 12 Lite	4	4	5	5	3
A9	Samsung Galaxy A23 5G	3	3	4	4	2
A10	Realmi 8 Pro	4	4	4	5	3
A11	Samsung Galaxy A32	1	3	4	4	2

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A12	Vivo Y15S	1	1	3	2	1
A13	Infinix Hot 10S	1	2	3	3	1

2) Calculation

The following are the steps in solving the problem of selecting recommended Android smartphones using the TOPSIS method.

1. Calculating the normalized decision matrix.

Before normalizing, first look for the divisor of the value of each CRITERIA by the root of the sum of the squares of each alternative.

$$|X_1|=\sqrt{5^2+5^2+4^2+5^2+5^2+5^2+3^2+4^2+3^2+4^2+1^2+1^2+1^2} = 13.928 \quad \text{(Processor)}$$

$$|X_2|=\sqrt{5^2+4^2+5^2+4^2+3^2+5^2+4^2+4^2+3^2+4^2+3^2+1^2+2^2} = 13.675 \quad \text{(ram)}$$

$$|X_3|=\sqrt{5^2+5^2+5^2+4^2+4^2+5^2+4^2+5^2+4^2+4^2+4^2+3^2+3^2} = 15.46 \quad \text{(internal)}$$

$$|X_4|=\sqrt{4^2+4^2+4^2+3^2+4^2+4^2+4^2+5^2+4^2+5^2+4^2+2^2+3^2} = 14.142 \quad \text{(Camera)}$$

$$|X_5|=\sqrt{5^2+5^2+5^2+5^2+4^2+4^2+3^2+3^2+2^2+3^2+2^2+1^2+1^2} = 13 \quad \text{(Price)}$$

After knowing the divisor of each CRITERIA value, then divide it by each decision matrix value, the results are in the following table:

Table 7 R Normalized Matrix

ALTERNATIVE	CRITERIA				
	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A1	0.359	0.366	0.323	0.283	0.385
A2	0.359	0.293	0.323	0.283	0.385
A3	0.287	0.366	0.323	0.283	0.385
A4	0.359	0.293	0.259	0.212	0.385
A5	0.359	0.219	0.259	0.283	0.308
A6	0.359	0.366	0.323	0.283	0.308
A7	0.215	0.293	0.259	0.283	0.231
A8	0.287	0.293	0.323	0.354	0.231
A9	0.215	0.219	0.259	0.283	0.154
A10	0.287	0.293	0.259	0.354	0.231
A11	0.072	0.219	0.259	0.283	0.154
A12	0.072	0.073	0.194	0.141	0.077
A13	0.072	0.146	0.194	0.212	0.077

2. Calculate the weighted normalized decision matrix.

The next step is to create a weighted normalized matrix denoted Y, the weighting is done by multiplying each value in the normalized decision matrix R with a preference weight vector symbolized by W which has been determined previously.

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The following are the calculation results for WEIGHT CRITERIA gaming :

Table 8. Normalized Matrix Y (CRITERIA Gaming)

RESULTS Y GAMING					
ALTERNATIVE	CRITERIA				
	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A1	1.795	1.828	1.294	0.566	0.385
A2	1.795	1.463	1.294	0.566	0.385
A3	1.436	1.828	1.294	0.566	0.385
A4	1.795	1.463	1.035	0.424	0.385
A5	1.795	1.097	1.035	0.566	0.308
A6	1.795	1.828	1.294	0.566	0.308
A7	1.077	1.463	1.035	0.566	0.231
A8	1.436	1.463	1.294	0.707	0.231
A9	1.077	1.097	1.035	0.566	0.154
A10	1.436	1.463	1.035	0.707	0.231
A11	0.359	1.097	1.035	0.566	0.154
A12	0.359	0.366	0.776	0.283	0.077
A13	0.359	0.731	0.776	0.424	0.077

The following are the calculation results for WEIGHT CRITERIA Content Creator:

Table 9. Normalized Matrix Y (CRITERIA Content Creator)

RESULTS Y CONTENT CREATOR					
ALTERNATIVE	CRITERIA				
	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A1	1.436	1.463	1.617	1.414	1.154
A2	1.436	1.170	1.617	1.414	1.154
A3	1.149	1.463	1.617	1.414	1.154
A4	1.436	1.170	1.294	1.061	1.154
A5	1.436	0.878	1.294	1.414	0.923
A6	1.436	1.463	1.617	1.414	0.923
A7	0.862	1.170	1.294	1.414	0.692
A8	1.149	1.170	1.617	1.768	0.692
A9	0.862	0.878	1.294	1.414	0.462
A10	1.149	1.170	1.294	1.768	0.692
A11	0.287	0.878	1.294	1.414	0.462
A12	0.287	0.293	0.970	0.707	0.231
A13	0.287	0.585	0.970	1.061	0.231

The following are the calculation results for WEIGHT CRITERIA low price:

Table 10. Normalized Matrix Y (CRITERIA Low Price)

RESULTS Y LOW PRICE

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ALTERNATIVE	CRITERIA				
	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A1	0.718	1.097	0.970	0.849	1.923
A2	0.718	0.878	0.970	0.849	1.923
A3	0.574	1.097	0.970	0.849	1.923
A4	0.718	0.878	0.776	0.636	1.923
A5	0.718	0.658	0.776	0.849	1.538
A6	0.718	1.097	0.970	0.849	1.538
A7	0.431	0.878	0.776	0.849	1.154
A8	0.574	0.878	0.970	1.061	1.154
A9	0.431	0.658	0.776	0.849	0.769
A10	0.574	0.878	0.776	1.061	1.154
A11	0.144	0.658	0.776	0.849	0.769
A12	0.144	0.219	0.582	0.424	0.385
A13	0.144	0.439	0.582	0.636	0.385

3. Determine the positive ideal solution and the negative ideal solution.

   Determine the maximum value and minimum value of the weighted value of each CRITERIA so that a positive ideal solution and a negative ideal solution are obtained.

   - The positive ideal solution is sought with the largest value of the weighted normalized value, so that the positive ideal solution can be found from the weighted normalized matrix.
   - The negative ideal solution is sought by means of the smallest value of the weighted normalized value, so that the negative ideal solution can be found from the weighted normalized matrix..

Table 11. Positive Ideal Solution and Negative Ideal Solution (CRITERIA Gaming)

	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A+	1.795	1.828	1.294	0.707	0.077
A-	0.359	0.366	0.776	0.283	0.385

Table 12. Positive Ideal Solution and Negative Ideal Solution (CRITERIA Content Creator)

	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A+	1.436	1.463	1.617	1.768	0.231
A-	0.287	0.293	0.97	0.707	1.154

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Table 13. Solusi Ideal Positif & Solusi Ideal Negatif (CRITERIA Low Price)

	PROCESSOR	RAM	INTERNAL	CAMERA	PRICE
A+	0.718	1.097	0.97	1.061	0.385
A-	0.144	0.219	0.582	0.424	1.923

4. Determines the distance from the positive ideal solution and the negative ideal solution with weighted normalized values.

   The weighted value of each alternative for the positive ideal solution and negative ideal solution for each use is obtained, in the following table:

Table 14. Distance of Alternative Values with Positive Ideal Solution Matrix and Negative Ideal Solution Matrix

GAMING		CONTENT CREATOR		LOW PRICE	
D+	D-	D+	D-	D+	D-
0.339	2.133	0.988	1.899	1.553	1.196
0.498	1.901	1.031	1.734	1.568	1.046
0.493	1.91	1.029	1.741	1.56	1.134
0.613	1.831	1.242	1.523	1.623	0.92
0.822	1.658	1.025	1.523	1.267	0.942
0.271	2.134	0.777	1.913	1.173	1.256
0.872	1.375	0.926	1.385	0.897	1.151
0.535	1.684	0.617	1.808	0.813	1.329
1.069	1.118	0.977	1.325	0.711	1.351
0.594	1.623	0.697	1.719	0.836	1.286
1.64	0.857	1.395	1.194	0.868	1.32
2.156	0.308	2.057	0.923	1.287	1.538
1.901	0.498	1.734	1.031	1.046	1.568

5. Specifies the preference value

The preference value is a final value benchmark that is used as a benchmark for determining the ranking of all existing alternatives. Denoted by V, the calculation is sought by determining the relative proximity to the ideal value.

After calculating, the results are obtained in the following table:

Table 15. V Preference Value results (Gaming Criteria)

GAMING Alternative

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ALTERNATIVE	NAME	VALUE
A1	Xiaomi 12 Pro	0.863
A2	Samsung Galaxy S22 5G	0.792
A3	Oppo Reno 8 Pro 5G	0.795
A4	Xiaomi Black Shark 4	0.749
A5	Asus Zenfone 9	0.669
A6	Realmi GT Neo 2 5G	0.887
A7	Vivo V23 5G	0.612
A8	Xiaomi 12 Lite	0.759
A9	Samsung Galaxy A23 5G	0.511
A10	Realmi 8 Pro	0.732
A11	Samsung Galaxy A32	0.343
A12	Vivo Y15S	0.125
A13	Infinix Hot 10S	0.208

Table 16. RESULTS VALUE Preference V (Criteria Content Creator)

ALTERNATIVE CONTENT CREATOR		
ALTERNATIVE	NAME	VALUE
A1	Xiaomi 12 Pro	0.658
A2	Samsung Galaxy S22 5G	0.627
A3	Oppo Reno 8 Pro 5G	0.628
A4	Xiaomi Black Shark 4	0.551
A5	Asus Zenfone 9	0.598
A6	Realmi GT Neo 2 5G	0.711
A7	Vivo V23 5G	0.599
A8	Xiaomi 12 Lite	0.745
A9	Samsung Galaxy A23 5G	0.576

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A10	Realmi 8 Pro	0.712
A11	Samsung Galaxy A32	0.461
A12	Vivo Y15S	0.310
A13	Infinix Hot 10S	0.373

Table 17 RESULTS VALUE Preference V (Criteria low price)

ALTERNATIVE LOW PRICE		
ALTERNATIVE	NAME	VALUE
A1	Xiaomi 12 Pro	0.435
A2	Samsung Galaxy S22 5G	0.400
A3	Oppo Reno 8 Pro 5G	0.421
A4	Xiaomi Black Shark 4	0.362
A5	Asus Zenfone 9	0.426
A6	Realmi GT Neo 2 5G	0.517
A7	Vivo V23 5G	0.562
A8	Xiaomi 12 Lite	0.621
A9	Samsung Galaxy A23 5G	0.655
A10	Realmi 8 Pro	0.606
A11	Samsung Galaxy A32	0.603
A12	Vivo Y15S	0.545
A13	Infinix Hot 10S	0.600

So that VALUE V can be sorted from largest to smallest VALUE, the RESULTS are in the following table:

Table 18. RESULTS VALUE Ranking Preference V (Criteria Gaming)

ALTERNATIVE GAMING		
ALTERNATIVE	NAME	VALUE
A6	Realmi GT Neo 2 5G	0.887

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A1	Xiaomi 12 Pro	0.863
A3	Oppo Reno 8 Pro 5G	0.795
A2	Samsung Galaxy S22 5G	0.792
A8	Xiaomi 12 Lite	0.759
A4	Xiaomi Black Shark 4	0.749
A10	Realmi 8 Pro	0.732
A5	Asus Zenfone 9	0.669
A7	Vivo V23 5G	0.612
A9	Samsung Galaxy A23 5G	0.511
A11	Samsung Galaxy A32	0.343
A13	Infinix Hot 10S	0.208
A12	Vivo Y15S	0.125

Table 19. RESULTS Ranking VALUE Preference V (Criteria Content Creator)

ALTERNATIVE CONTENT CREATOR		
ALTERNATIVE	NAME	VALUE
A8	Xiaomi 12 Lite	0.745
A10	Realmi 8 Pro	0.712
A6	Realmi GT Neo 2 5G	0.711
A1	Xiaomi 12 Pro	0.658
A3	Oppo Reno 8 Pro 5G	0.628
A2	Samsung Galaxy S22 5G	0.627
A7	Vivo V23 5G	0.599
A5	Asus Zenfone 9	0.598
A9	Samsung Galaxy A23 5G	0.576
A4	Xiaomi Black Shark 4	0.551
A11	Samsung Galaxy A32	0.461
A13	Infinix Hot 10S	0.373
A12	Vivo Y15S	0.310

Table 20 RESULTS Ranking VALUE Preference V (Criteria low price)

ALTERNATIVE LOW PRICE		
ALTERNATIVE	NAME	VALUE
A9	Samsung Galaxy A23 5G	0.655

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A8	Xiaomi 12 Lite	0.621
A10	Realmi 8 Pro	0.606
A11	Samsung Galaxy A32	0.603
A13	Infinix Hot 10S	0.600
A7	Vivo V23 5G	0.562
A12	Vivo Y15S	0.545
A6	Realmi GT Neo 2 5G	0.517
A1	Xiaomi 12 Pro	0.435
A5	Asus Zenfone 9	0.426
A3	Oppo Reno 8 Pro 5G	0.421
A2	Samsung Galaxy S22 5G	0.400
A4	Xiaomi Black Shark 4	0.362

4. CONCLUSION

Based on research that has been carried out in the Android smartphone recommendation decision support system using the TOPSIS method, the following conclusions can be drawn:

1. This system has been successfully developed in general and can be used to support decisions in determining smartphone recommendations based on usability criteria and predetermined price budgets by displaying alternative ranking data from the largest value to the smallest value which has been calculated using the TOPSIS method (Technique for Others Preference by Similarity to Ideal Solution).
2. The results of black box testing show that this decision support system is running in accordance with the rules and system design that have been determined.

Based on the research that has been carried out, there are several suggestions that need to be considered in developing research, including:

1. This decision support system can be developed as user needs develop so that it can improve system performance.
2. Because the TOPSIS method has a weakness, namely that there is no priority weight for calculating the criteria, which is used to increase the validity of the weight values for calculating the criteria. So for this reason, it is recommended that future researchers combine this method with other methods, for example AHP, in order to overcome the weighting problem and produce maximum output or decisions.
3. To build this system in the future, it is hoped that more detailed and complete information will be added so that users can get more accurate information.
4. With the large number of smartphone users nowadays, it is recommended to implement or create a system in the form of an Android/IOS application so that it can be accessed more easily and globally.

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