VOL. 10. NO. 1 AUGUST 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480 /jitk.v10i1.5163

JITK (JURNAL ILMU PENGETAHUAN DAN TEKNOLOGI KOMPUTER)

ELECTRIC BICYCLE SELECTION SYSTEM USING MULTI CRITERIA DECISION MAKING

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Abstract— *Indonesia government has targeted that by 2025 electric vehicle production has reached 20%. Many electric bicycle products have been sold and used in Indonesia, both domestically made and imported. The most important technical considerations in choosing an electric bicycle are battery type and motor used. These two components affect distance traveled by electric bicycles even further. Many brands offered by manufacturers with various advantages and disadvantages will make consumers are confused about choosing a quality and durable electric bicycle. From these problems, one solution is to create a mobile-based decision support system (DSS) that can assist in making decisions according to predetermined criteria. This research aims to produce recommendations for electric bicycle brands that can assist potential consumers in choosing electric bicycles. The combination of the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods is used in order to produce more objective recommendations. In this research uses seven criteria that will be processed in AHP, namely price, maximum load, battery capacity, motor power, charging time, mileage and speed. There are nine brands that are used as alternatives in the TOPSIS calculation. From AHP and TOPSIS calculation, following recommendations for electric bicycles is obtained: the first order is the Ofero with a preference value of 1, next order are with the same value 0.5806, Indobike and Exotic, and the last recommendation is Jarvis with a value of 0.095.*

Keywords*: AHP, decision making, electric bicycle selection, TOPSIS.*

Intisari— Pemerintah menargetkan produksi kendaraan listrik di tahun 2025 sudah mencapai 20%. Banyak produk sepeda listrik sudah dijual dan digunakan di Indonesia baik buatan dalam negeri maupun yang import. Pertimbangan teknis yang paling utama dalam memilih sepeda listrik adalah jenis baterai dan motor yang digunakan. Dua komponen tersebut mempengaruhi jarak tempuh sepeda listrik menjadi semakin jauh. Semakin banyak merk yang ditawarkan pabrikan dengan berbagai kelebihan dan kekurangannya akan membuat calon konsumen kebingungan untuk memilih sepeda listrik yang berkualitas dan awet. Dari permasalahan tersebut, salah satu solusi adalah dengan pembuatan sistem pendukung keputusan (SPK) berbasis *mobile* atau android yang dapat membantu dalam mengambil keputusan sesuai kriteria yang telah ditentukan. Penelitian ini bertujuan untuk menghasilkan rekomendasi merk sepeda listrik yang dapat membantu calon konsumen dalam memilih sepeda listrik. Kombinasi metode *Analytical Hierarchy Process* (AHP) dan *Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS) digunakan agar dapat menghasilkan rekomendasi yang lebih objektif. Penelitian ini menggunakan tujuh kriteria yang akan diproses dalam AHP yaitu harga, maksimal beban, kapasitas baterai, daya motor, lama pengisian, jarak tempuh dan kecepatan. Terdapat sembilan merk yang dijadikan alternatif dalam perhitungan TOPSIS. Dari hasil perhitungan metode AHP dan TOPSIS didapatkan rekomendasi sepeda listrik sebagai berikut : urutan pertama ialah merk Ofero dengan nilai preferensi 1, urutan selanjutnya dengan nilai yang sama 0,5806 yaitu Indobike dan Exotic, dan rekomendasi terakhir adalah merk Jarvis dengan nilai 0,095.

Kata Kunci*: AHP, pengambilan keputusan, pemilihan sepeda listrik, TOPSIS.*

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INTRODUCTION

Majority of Indonesians prefer two-wheeled vehicles as a means of transportation for their daily activities because they are cheap and more flexible in traffic jams. This is what causes the use of motorbikes to increase every year and causes air pollution to get worse [1]. Using energy derived from fossils such as petroleum is still dominant as vehicle fuel today [2]. Decreasing natural resources of petroleum and increasing prices in various countries including Indonesia require alternative energy for vehicles, one of which is electric or direct electricity (DC) [3]. Development of electric vehicles, especially two-wheeled vehicles, is an effort to reduce use of fossil fuels. Using electric vehicles can also reduce air pollution [4]. Electric vehicles are currently increasingly developing, especially in Indonesia. Various efforts are accompanied by support from the government to follow global trends in reducing air pollution. The government targets that by 2025 electric vehicle production will reach 20% [5].

Bicycles are a means of transportation that were used before the existence of motorized vehicles. Bicycles are personal mobility tools that are light and environmentally friendly. Bicycles can be ridden on small and large roads by everyone without having to have a driving license (SIM) [6]. In the era of industrial revolution 4.0, the era of digitalization and modernization, human powered bicycles have evolved into electric powered bicycles. Addition of electric features to bicycles will make it easier for users to cover long distances because it can reduce energy expended by rider [7]. An electric bicycle is an ordinary bicycle equipped with an electric motor that drives bicycle and takes electrical energy from the battery. There are 4 main parts of an electric bicycle, namely the rechargeable battery, electric motor, frame, gears, chain and brakes [8]. In general, there are several similarities between electric bicycles and manual bicycles, such as physically the shape of electric bicycles is not much different from ordinary bicycles, these electric bicycles still use pedals and human power as propulsion [9]. The difference between electric bicycles and bicycles in general is that there is a rechargeable battery with a power of 250-1000 watts and an electric motor. Electric batteries and electric motors can be used as auxiliary power in pedaling and/or as the main driving force for a certain time [10].

Electric bicycles are widely sold and used in Indonesia. Some of products marketed are still imported from China, such as electric bicycles from Xiaomi, Marokat, Hongdu brands and so on. Now there are many domestic products such as Indobike, Selis, viar, Polygon and many more [11]. Some technical considerations in choosing an electric bicycle include type of battery and motor used. The most important component of an electric bicycle is the battery as energy storage to increase pedal power [12]. Lithium ion batteries are rechargeable batteries used in many electric vehicles today. In these batteries lithium ions move from negative electrode to positive electrode during discharge and back during charging. It is more efficient due to lighter weight, high speed and no pollution [13]. Following motor power ratings are expressed in terms of maximum continuous operating torque or equivalent to maximum continuous power rating. Using permanent magnet synchronous motors can now achieve high efficiency. Range of electric bicycles increases by consuming only a small amount of battery [14]. Increasing number of electric bicycle brands and features offered with various advantages and disadvantages makes it difficult for potential consumers to choose an electric bicycle that suits their needs and abilities [15].

From the problems in choosing an electric bicycle, a solution is needed to help potential consumers to buy according to their needs. One solution is to create a decision support system (DSS) that can be used widely and helps in making decisions according to predetermined criteria [16]. DSS is a system as a supporting tool that is useful for assisting decision making in an organization or agency or company [17]. DSS can also be defined as a computer-based system for processing data and producing information to support decision making for specific semi-structured problems [18]. T

his research uses a combination of two methods in DSS, that are Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). AHP can organize information that has many alternatives and provide value for each criterion objectively. Resulting value shows the criteria that have the highest priority and influence the resolution of existing problems [19]. AHP method has the advantage of creating a pairwise comparison matrix to determine weight of each criterion and calculate the consistency value [20]. TOPSIS method will compare all existing alternatives with the best and worst alternatives from TOPSIS calculations so that it can produce a solution from the alternatives that have been determined [21].

Alternatives selected based on TOPSIS is not only the one that has shortest distance from the positive ideal value but also the one that has longest distance from negative ideal value. AHP method

focuses on the criteria weighting process, while TOPSIS evaluates each existing alternative [22].

Until now there has been no journal publication of research results on choosing an electric bicycle. Journals of previous research results using the AHP and TOPSIS methods have been widely published and are used as references in this research. Research conducted by Hutagalung used six criterias, they are business ownership status, ability, character, collateral, income and salary.

Weight of each criterion from calculation results in AHP becomes the basis for TOPSIS calculations to produce a sequence of the 13 existing alternatives. Final value of sorting results is categorized into three: very feasible (>=0.7), feasible (0.6 to 0.69) and not feasible [23]. Willyandi and Septiani's research used five criterias whose weight will be calculated in AHP, they are price, filling accuracy, filling speed, lead time availability and maintenance team. Based on sensitivity analysis, it is known that the selected machine alternative is influenced by the criteria of price and filling speed. The results of the analysis state that the sensitivity of the machine price criteria is in the range of 0.6–0.8, while the filling speed criterion is in the range of 0.4–0.6 [24].

Ryando, Mariana and Hakim's research is similar to this research. System was created on a web basis to help people no longer need to be confused in searching for the criteria and alternatives offered. Five criterias are used in selecting a used automatic motorbike, namely: price, completeness of documents, year of assembly, condition and authenticity of spare parts. Using AHP to determine the priority weights of criteria to produce a consistency ratio that can be used. These weights are used as the basis for the process in TOPSIS to produce distances to positive and negative ideal solutions. The final result is to rank the preference values of the five existing alternatives [25].

In this research, a system was developed to produce recommendations for electric bicycles brands that potential consumers would buy using seven criteria. The seven criteria used are price, maximum load, battery capacity, drive motor, charging time, mileage and maximum speed. AHP method is used to calculate each criterion weight whose consistency has been tested. The weights from AHP process will be used in TOPSIS method to determine positive and negative ideal solutions which ultimately produce a recommendation sequence for electric bicycle brands that have been entered previously.

MATERIALS AND METHODS

1. Data Types and Sources

In developing DSS two types of data are needed for the process in method used, they are criteria and alternative data. Required data is obtained in various ways and from reliable sources. The following is an explanation of the data sources and the data obtained.

Alternative data in this research is electric bicycle data obtained from the brochures of each electric bicycle shop and also obtained from the official website of the electric bicycle manufacturer. The brands of electric bicycles recommended or used in this research are presented in Table 1.

Table 1. Electric Bicycle Brands

No	Code	Brands
1	A1	Indobike
2	A2	Selis
3	A3	Viar
4	A4	Uwinfly
5	A5	United
6	A6	Goda
7	A7	Exotic
8	A8	Ofero
9	A9	Jarvis

Source : (Research Results, 2024)

Criteria are measures that serve as a reference for assessing or determining something, in this case an electric bicycle [26]. Several criteria can be used as a basis for determining the quality of an electric bicycle brand. Criterias for electric bicycles used in this research are presented in Table 2.

Table 2. Electric Bicycle Criteria

No	Code	Criteria	Unit
1	K1	Price	Rupiah
2	K2	Maksimum Load	Kilograms
3	K3	Battery capacity	Volt
4	K4	Motor power	Watt
5	K5	Charging time	Hour
6	K6	Mileage	Kilometers
7	K7	Speed	Km/hour

Source: (Research Results, 2024)

2. Data Collection and Processing

Calculating the priority scale or importance of each criterion using a supervised method, specifically providing a special logical framework for assigning priority or importance values to criterias. Logic values are given using a scale of 1 to 4 as follows:

1: These criteria are not that important
2: These criteria are less important
3: These criteria are important
4: These criteria are very important

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According to obtained from the survey results of 50 respondents values, it can be seen in Table 3.

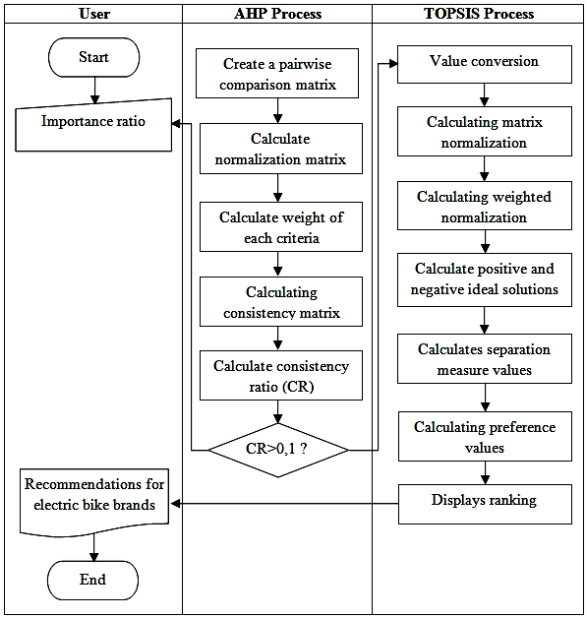
Table 3. Respondent Survey Results

Criteria	C1	C2	C3	C4	C5	C6	C7
Not important (1)		8	30		11		
Less important (2)		42	20	7	25		3
Important (3)	26			8	14	5	17
Very important (4)	24			35		45	31
Result	3	2	1	4	2	4	4

Source: (Research Results, 2024)

3. System Development

DSS diagram flow created in this research is presented in Figure 1.



Source: (Research Results, 2024)

Figure 1. Developed System Flow Chart

The steps in AHP method produce input needed in TOPSIS method. AHP starts from entering the importance ratio which forms a pairwise comparison matrix, creating a normalization matrix to calculating the weights of each criterion, creating a consistency matrix to determine ratio value weights. If ratio value is <0.01 then resulting weight is consistent. Weight of each criterion from AHP calculation results will be used as the basis for TOPSIS method to determine alternative to be selected.

RESULTS AND DISCUSSION

1. AHP Process

The first process carried out in this DSS is to determine the priority criteria by creating a pairwise comparison matrix in AHP. Pairwise comparison matrix will produce importance level of each criterion based on the results of the survey that has been carried out. The pairwise comparison matrix is presented in Table 4.

Table 4. Pairwise Comparison Matrix

	C1	C2	C3	C4	C5	C6	C7
C1	1	3	5	0,33	3	0,33	0,33
C2	0,33	1	3	0,2	1	0,2	0,2
C3	0,2	0,33	1	0,2	0,33	0,14	0,14
C4	3	5	5	1	5	1	1
C5	0,33	1	3	0,2	1	0,2	0,2
C6	3	5	7,14	1	5	1	1
C7	3	5	7,14	1	5	1	1
Sum	10,87	20,3	31,3	3,93	20,3	3,87	3,87

Source: (Research Results, 2024)

From each value and the number of each column in Table 4, it can be calculated to produce a normalization matrix and the weight of each criterion. Weight of each criterion is obtained from the average of each row in the normalization matrix which is presented in Table 5.

Table 5. AHP Normalization Matrix

	C1	C2	C3	C4	C5	C6	C7	Weight
C1	0,09	0,15	0,16	0,08	0,15	0,09	0,09	0,115
C2	0,03	0,05	0,1	0,05	0,05	0,05	0,05	0,054
C3	0,02	0,02	0,03	0,05	0,02	0,04	0,04	0,029
C4	0,28	0,25	0,16	0,25	0,25	0,26	0,26	0,243
C5	0,03	0,05	0,1	0,05	0,05	0,05	0,05	0,054
C6	0,28	0,25	0,23	0,25	0,25	0,26	0,26	0,252
C7	0,28	0,25	0,23	0,25	0,25	0,26	0,26	0,252

Source: (Research Results, 2024)

From each value contained in Table 4 and weight of each corresponding criterion can be calculated to produce a consistency matrix. In consistency matrix, total value of each row is calculated as a basis for calculating quotient. Quotient is obtained from dividing total row values in consistency matrix with appropriate criteria weights in Table 5. Consistency matrix is presented in Table 6.

Table 6. Consistency Matrix

	C1	C2	C3	C4	C5	C6	C7	Quotient
C1	0,11	0,16	0,15	0,08	0,16	0,08	0,08	7,82
C2	0,04	0,05	0,09	0,05	0,05	0,05	0,05	7,1
C3	0,02	0,02	0,03	0,05	0,02	0,04	0,04	7,05
C4	0,34	0,27	0,15	0,24	0,27	0,25	0,25	7,34
C5	0,04	0,05	0,09	0,05	0,05	0,05	0,05	7,1
C6	0,34	0,27	0,21	0,24	0,27	0,25	0,25	7,31
C7	0,34	0,27	0,21	0,24	0,27	0,25	0,25	7,31

Source: (Research Results, 2024)

From the quotient value produced in Table 6, the λmax value can be calculated which will later be used as the basis for calculating the consistency index (CI). The following is how to calculate λmax and CI.

$$\lambda max = \frac{7,827,1 + 7,05 + 7,34 + 7,1 + 7,31 + 7,31}{7}$$
$$= 7,21$$

$$CI = \frac{7,21 - 7}{6} = 0,04$$

Consistency of the resulting weights based on pairwise assessments is then evaluated by calculating the consistency ratio (CR). If CR <= 0.1 then Weights and pairwise comparisons are declared consistent.

$$CR = \frac{0,04}{1,41} = 0,03$$

CR value is 0.03 so it is consistent and weight produced by AHP can be used for calculations in TOPSIS.

2. TOPSIS Process

The initial stage in TOPSIS is to convert values from predetermined criteria. Conversion of criteria values is presented in Table 7.

Table 7. Value Conversion

C1 (mil.)	C2	C3	C4	C5	C6	C7	Value
>6	<130	20-30	200-300	>6	25-35	20-30	1
4,5-6	130-140	30-40	300-400	5-6	35-45	30-40	2
3-4,5	140-150	40-50	400-500	4-5	45-55	40-50	3
<3	>150	>50	>500	<4	>55	>50	4

Source: (Research Results, 2024)

Before TOPSIS process, first step is fill in the alternative in form of data on electric bicycle that will be used. There are nine alternatives in electric bicycle products form and they are presented in Table 1. Based on the range of values from Table 7 and specifications of each electric bicycle, a comparison of alternatives and criteria is obtained as presented in table 8. Weights in Table 8 are obtained from the AHP process in table 5 and their values has been consistent.

Table 8. Alternatives and Criteria Comparison

	C1	C2	C3	C4	C5	C6	C7
A1	2	4	3	3	2	2	3
A2	3	3	2	2	3	1	1
A3	2	4	3	2	2	4	1
A4	3	1	3	3	3	2	2
A5	3	1	3	3	2	4	1
A6	2	3	3	3	3	2	3
A7	2	4	3	3	2	2	3
A8	3	4	3	3	3	4	3
A9	2	3	2	2	3	1	1
Weight	0,115	0,054	0,02	0,243	0,054	0,252	0,252

Source: (Research Results, 2024)

From each square value in Table 8 and the root of each corresponding column total, a normalization matrix can be obtained as presented in Table 9. For example, total of each square value of column C1 = 56 and root of 56 is 7.48. To obtain value in column 1 row 1 of Table 9, it is obtained from the value in column 1 row 1 of table 8 divided by 7.48 = 2/7.48 = 0.267.

Table 9. TOPSIS Normalization Matrix

	C1	C2	C3	C4	C5	C6	C7
A1	0,267	0,415	0,356	0,369	0,256	0,246	0,452
A2	0,401	0,311	0,237	0,246	0,384	0,123	0,151
A3	0,267	0,415	0,356	0,246	0,256	0,492	0,151
A4	0,401	0,104	0,356	0,369	0,384	0,246	0,302
A5	0,401	0,104	0,356	0,369	0,256	0,492	0,151
A6	0,267	0,311	0,356	0,369	0,384	0,246	0,452
A7	0,267	0,415	0,356	0,369	0,256	0,246	0,452
A8	0,401	0,415	0,356	0,369	0,384	0,492	0,452
A9	0,267	0,311	0,237	0,246	0,384	0,123	0,151

Source: (Research Results, 2024)

From each value in Table 9 multiplied by corresponding weight from Table 8, a weighted normalization matrix can be produced which is presented in Table 10. To fill in column 2 row 1 of table 10, it is obtained from value of column 2 row 1 of Table 9 multiplied by the weight of column 2 of Table 8 (0.267 x 0.115 = 0.031). Next, calculate the positive (S+) and negative (S-) ideal solution values. S+ value is taken from the largest value in each column while the S- value is taken from the smallest value in each column.

Table 10. Weighted Normalization Matrix

	C1	C2	C3	C4	C5	C6	C7
A1	0,031	0,022	0,01	0,09	0,014	0,062	0,114
A2	0,046	0,017	0,007	0,06	0,021	0,031	0,038
A3	0,031	0,022	0,01	0,06	0,014	0,124	0,038
A4	0,046	0,006	0,01	0,09	0,021	0,062	0,076
A5	0,046	0,006	0,01	0,09	0,014	0,124	0,038
A6	0,031	0,017	0,01	0,09	0,021	0,062	0,114
A7	0,031	0,022	0,01	0,09	0,014	0,062	0,114
A8	0,046	0,022	0,01	0,09	0,021	0,124	0,114
A9	0,031	0,017	0,007	0,06	0,021	0,031	0,038
S+	0,046	0,022	0,01	0,09	0,021	0,124	0,114
S-	0,031	0,006	0,007	0,06	0,014	0,031	0,038

Source: (Research Results, 2024)

From Table 10 values, alternative distances can be calculated from ideal solution (separation measure) which is abbreviated as sep+ and sep-. Preference value is obtained from sep+ (sep- + sep+). Calculating distance results of positive, negative and preferential ideal solutions are presented in Table 11.

Table 11. Distance of Positive, Negative and Preferential Ideal Solutions

Alternative	Sep+	Sep-	Preference
A1	0,064	0,089	0,581

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Alternative	Sep+	Sep-	Preference
A2	0,124	0,02	0,14
A3	0,083	0,095	0,532
A4	0,075	0,06	0,445
A5	0,078	0,099	0,559
A6	0,064	0,088	0,579
A7	0,064	0,089	0,581
A8	0	0,126	1
A9	0,125	0,013	0,095

Source: (Research Results, 2024)

From Table 11, the largest to smallest preference values have been obtained. Alternative with the greatest preference value is the recommendation for choosing an electric bicycle brand. The order of alternatives from the most recommended to the worst option is presented in Table 12.

Table 12. Order of Recommended Electric Bicycle Brands

Alternative	Value	Brand
A8	1	Ofero
A1	0,58066	Indobike
A7	0,58066	Exotic
A6	0,57946	Goda
A5	0,55895	United
A3	0,53159	Viar
A4	0,44543	Uwinfly
A2	0,1403	Selis
A9	0,09531	Jarvis

Source: (Research Results, 2024)

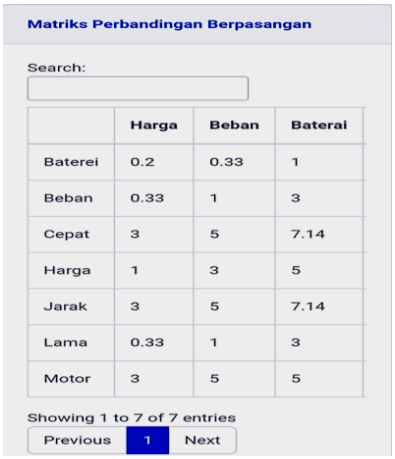
From the order in Table 12 it is known that the brand most recommended by the system is Ofero, next with the same value is Indobike and Exotic and so on in order.

3. Implementation System of AHP Process

Input the importance ratio value in the system that has been created and produce Table 4 as shown in Figure 2.

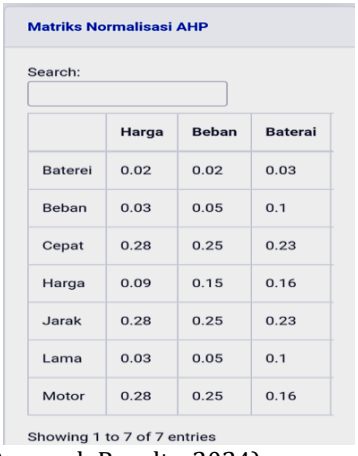
Source: (Research Results, 2024)
Figure 2. Importance Ratio Input Page

From data input, comparison ratio in Figure 3 is calculated by system and produces a pairwise comparison matrix. Pairwise comparison matrix values produced by the system are same as manual calculations presented in table 5. From pairwise comparison matrix values and number of each column, the system then calculates it to produce a normalization matrix as in Figure 4 whose values are in accordance with manual calculations as in Table 6.



Source: (Research Results, 2024)
Figure 3. Pairwise Comparison Matrix Display

From pairwise comparison matrix values and number of each column, the system then calculates it to produce a normalization matrix as in Figure 4 whose values are in accordance with manual calculations as in Table 6.



Source: (Research Results, 2024)
Figure 4. AHP Normalization Matrix Display

From normalization matrix results and weight values for each criterion, system performs calculations to display the consistency matrix as in Figure 5. In this process, the λmax, CI and CR values have also been calculated and displayed.

Matriks Konsistensi AHP

Search:

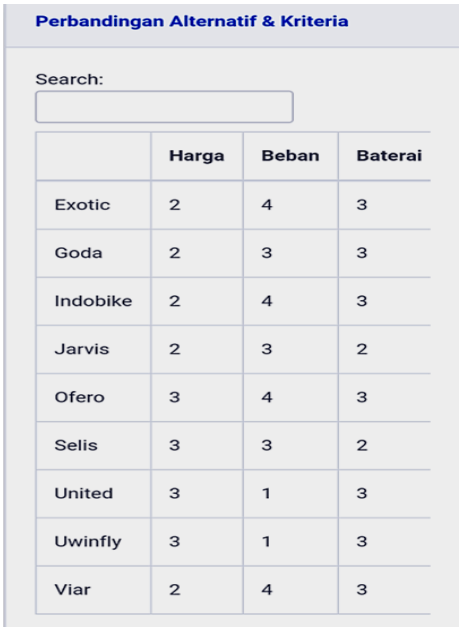
	Harga	Beban	Baterai
Harga	0.11	0.16	0.15
Beban	0.04	0.05	0.09
Baterei	0.02	0.02	0.03
Motor	0.34	0.27	0.15
Lama	0.04	0.05	0.09
Jarak	0.34	0.27	0.21
Cepat	0.34	0.27	0.21

$\lambda max = 7{,}21$ $CI = \frac{7.21-7}{6} = 0{,}04$ $CR = \frac{0{,}04}{1{,}41} = 0{,}03$

Source: (Research Results, 2024)
Figure 5. AHP Consistency Matrix Display

4. Implementation System of TOPSIS Process

Value conversion is carried out using program code so that system only displays information on comparison of criteria and alternatives as shown in Figure 6.



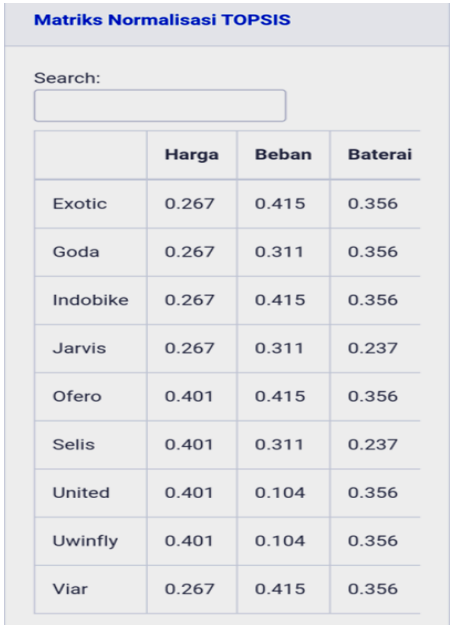
Perbandingan Alternatif & Kriteria

Search:

	Harga	Beban	Baterai
Exotic	2	4	3
Goda	2	3	3
Indobike	2	4	3
Jarvis	2	3	2
Ofero	3	4	3
Selis	3	3	2
United	3	1	3
Uwinfly	3	1	3
Viar	2	4	3

Source: (Research Results, 2024)
Figure 6. Alternatives and Criteria Comparison

From values in Table 6, system creates a normalization matrix. Calculation results in Figure 7 are in accordance with manual calculations as in Table 9.



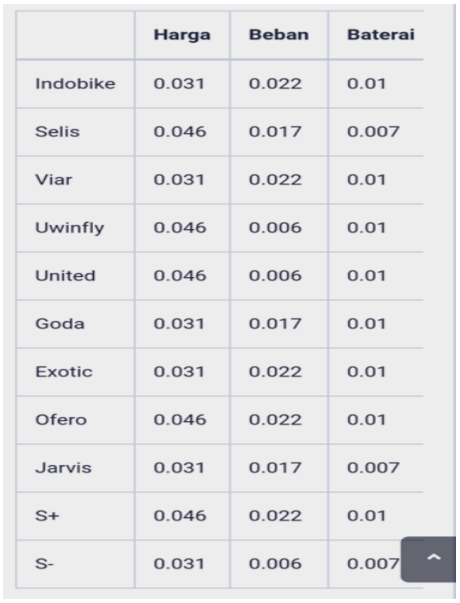
Matriks Normalisasi TOPSIS

Search:

	Harga	Beban	Baterai
Exotic	0.267	0.415	0.356
Goda	0.267	0.311	0.356
Indobike	0.267	0.415	0.356
Jarvis	0.267	0.311	0.237
Ofero	0.401	0.415	0.356
Selis	0.401	0.311	0.237
United	0.401	0.104	0.356
Uwinfly	0.401	0.104	0.356
Viar	0.267	0.415	0.356

Source: (Research Results, 2024)
Figure 7. TOPSIS Normalization Matrix Display

Values in Figure 7 and weights produced in AHP method whose consistency has been tested, weighted normalization matrix can be calculated as shown in Figure 8. Weighted normalization matrix produced by system is in accordance with manual calculations contained in Table 10 and the values have been calculated. positive and negative ideal solutions required for ranking.



	Harga	Beban	Baterai
Indobike	0.031	0.022	0.01
Selis	0.046	0.017	0.007
Viar	0.031	0.022	0.01
Uwinfly	0.046	0.006	0.01
United	0.046	0.006	0.01
Goda	0.031	0.017	0.01
Exotic	0.031	0.022	0.01
Ofero	0.046	0.022	0.01
Jarvis	0.031	0.017	0.007
S+	0.046	0.022	0.01
S-	0.031	0.006	0.007

Source: (Research Results, 2024)
Figure 8. Weighted Normalization Matrix Display

Final result of this system is priority order produced by TOPSIS as shown in Figure 9.

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

VOL. 10. NO. 1 AUGUST 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v10i1.5163

Source: (Research Results, 2024)

Figure 9. Order of Recommendations for Electric Bicycle

Testing the success or accuracy of research results is carried out by comparing the sequence results produced by system with analysis of 3 experts results. The three experts are practitioners and academics in the automotive field and electric vehicle observers. The first expert is Agus Kristianto, a lecturer and automotive practitioner, the second is Agus Widianto, an electric vehicle mechanic and David Budiman, owner of an electric bicycle dealer with various brands. System accuracy test results presented in table 13.

Table 13. System Success Test Results

Expert	Ranking	Alternative	Explanation
Expert 1	1	Ofero	Suitable
	2	United	Not Suitable
	3	Exotic	Suitable
	4	Goda	Suitable
	5	Indobike	Not Suitable
	6	Viar	Suitable
	7	Uwinfly	Suitable
	8	Selis	Suitable
	9	Jarvis	Suitable
Expert 2	1	Indobike	Not Suitable
	2	Exotic	Not Suitable
	3	Ofero	Not Suitable
	4	Goda	Suitable
	5	United	Suitable
	6	Viar	Suitable
	7	Uwinfly	Suitable
	8	Selis	Suitable
Expert 3	9	Jarvis	Suitable
	1	Ofero	Suitable
	2	Indobike	Suitable
	3	Exotic	Suitable
	4	Jarvis	Not Suitable
	5	United	Suitable
	6	Viar	Suitable
	7	Goda	Not Suitable
	8	Selis	Suitable
	9	Uwinfly	Not Suitable

Source: (Research Results, 2024)

CONCLUSION

An android based DSS design and application has been developed to produce a sequence of recommendations for choosing an electric bicycles. There are seven criteria that are used as basis for choosing an electric bicycle, namely price, maximum load, battery capacity, motor power, charging time, distance traveled and speed. From existing criteria that have been produced, weights or eigenvalues in AHP method are then used as a reference in TOPSIS method process. Based on nine brands of electric bicycles that were used as alternatives and have been processed using TOPSIS method, the following order of recommendations for electric bicycle brands was produced: the most recommended is Ofero brand with a preference value of 1, next sequence is two brands with the same value of 0.5806, that are Indobike and Exotic, Below that is the Goda brand which has a value of 0.5795, until the last recommendation is the Jarvis brand with a value of 0.095.

Of the series of trials that have been carried out in this research, there are certainly shortcomings that still need to be corrected for further research. So that the system can be more objective in producing recommendations for electric bicycle brands, more electric bicycle brands can be added considering that there are more brand choices being offered. More interest or priority level surveys.

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