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DSS for Keyboard Mechanical Selection Using AHP and Profile Matching Method

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Abstrak

Keyboard mekanik dirancang dengan berbagai bentuk, variasi, dan spesifikasi yang berbeda dengan jenis keyboard lainnya. Keyboard mekanik sendiri memiliki fungsi estetik yang memungkinkan penggunanya untuk melakukan kustomisasi. Adanya berbagai spesifikasi pada keyboard mekanik, menyebabkan munculnya berbagai pertimbangan, yang dapat menyulitkan pengguna dalam memilih keyboard mekanik yang sesuai dengan kriteria yang diinginkan. Didukung dengan hasil pengamatan dalam Indonesia Mechanical Keyboard Group (IMKG), beberapa pengguna masih terbatas pengetahuannya mengenai produk keyboard mekanik yang tersedia di Indonesia, juga, saat ini belum terdapat solusi yang dapat menangani permasalahan tersebut.

Diangkat dari permasalahan tersebut, pada penelitian ini dibangun sebuah SPK yang dapat membantu mengatasi masalah tersebut, dengan memberikan rekomendasi keyboard mekanik yang sesuai dengan keinginan pengguna. SPK diimplementasikan dalam bentuk web menggunakan metode AHP untuk proses pembobotan dan Profile Matching untuk proses skoring. Kriteria yang digunakan ditentukan dengan melakukan survei mengenai spesifikasi yang menjadi prioritas pertimbangan dalam memilih keyboard mekanik.

Di akhir penelitian, SPK yang berhasil dibangun mampu memberikan rekomendasi prioritas keyboard mekanik yang sesuai dengan preferensi pengguna dan mendapatkan rata-rata hasil evaluasi sebesar 36.17 dari total nilai maksimal 40.

Kata kunci*—Sistem Pendukung Keputusan, SPK, AHP, Profile Matching, Keyboard Mekanik*

Abstract

Mechanical keyboards are designed with various shapes, variations, and specifications that are different from other types of keyboards. The mechanical keyboard itself has an aesthetic function that allows users to customize it. There are various specifications on mechanical keyboards, causing various considerations, which can make it difficult for users to choose a mechanical keyboard that fits the desired criteria. Supported by observations in the Indonesia Mechanical Keyboard Group (IMKG), some users are still limited in their knowledge of mechanical keyboard products available in Indonesia, also, currently there is no solution that can handle this problem.

Based on these problems, in this research, an DSS is built that can help overcome these problems, by providing recommendations for a mechanical keyboard according to the wishes of the user. DSS is implemented in web form using the AHP method for the weighting process and Profile Matching for the scoring process. The criteria used are determined by conducting a survey regarding the specifications that are the priority considerations in choosing a mechanical keyboard.

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At the end of the study, the DSS that was successfully built was able to provide mechanical keyboard priority recommendations according to user preferences and get an average evaluation result of 36.17 out of a total maximum value of 40.

Keywords—*Decision Support System, AHP, Profile Matching, Mechanical Keyboard.*

1. INTRODUCTION

Keyboard is one of the computer hardware that has an important role in providing input. With the keyboard, users can enter characters and functions into the computer system by simply pressing a button. Some keyboards not only act as input devices, but also have aesthetic and customization functions. One type of keyboard that supports this function is a mechanical keyboard.

Mechanical keyboards are designed with various shapes, variations, and specifications that are different from other types of keyboards. The mechanical keyboard itself has various specifications and variations and has an aesthetic function that allows users to customize it. With so many different specifications and variations, various considerations arise in determining the choice of a mechanical keyboard that suits you [1].

From these problems, the existence of a mechanical keyboard selection decision support system can help provide mechanical keyboard recommendations that are in accordance with the wishes of the user. The mechanical keyboard selection decision support system can assist users in finding mechanical keyboard options, by displaying product recommendations that match the criteria desired by the user.

The system is implemented in web form using the AHP weighting method and Profile Matching in decision making. The AHP weighting method is used to assist the weighting process, while the Profile Matching method is used to assess the criteria that are close to the ideal value desired by the decision maker.

The AHP method was chosen because it is a multi-criteria decision-making technique in which decision makers set priorities and determine decisions by making pairwise comparisons between criteria to get priorities in each hierarchy (saaty, 1987) [2]. While the Profile Matching method was chosen because there is an ideal level of predictor variables in each available alternative, not a minimum level that must be passed (Kusrini, 2007) [3].

Therefore, this final project discusses the development of a mechanical keyboard selection decision support system using the AHP weighting method and Profile Matching.

2. METHODS

2.1 Research Description

In this study, the system was built using the AHP weighting method for weighting and Profile Matching for the scoring process on criteria that require user preferences. The flow of using the method on the system is shown.

First, the user provides AHP matrix input, then inputs the desired mechanical keyboard target value / preference criteria. The system will then process the input value from the user, and then display the appropriate keyboard recommendation results. For more details, the flow of using the method is shown in Figure 1 below.

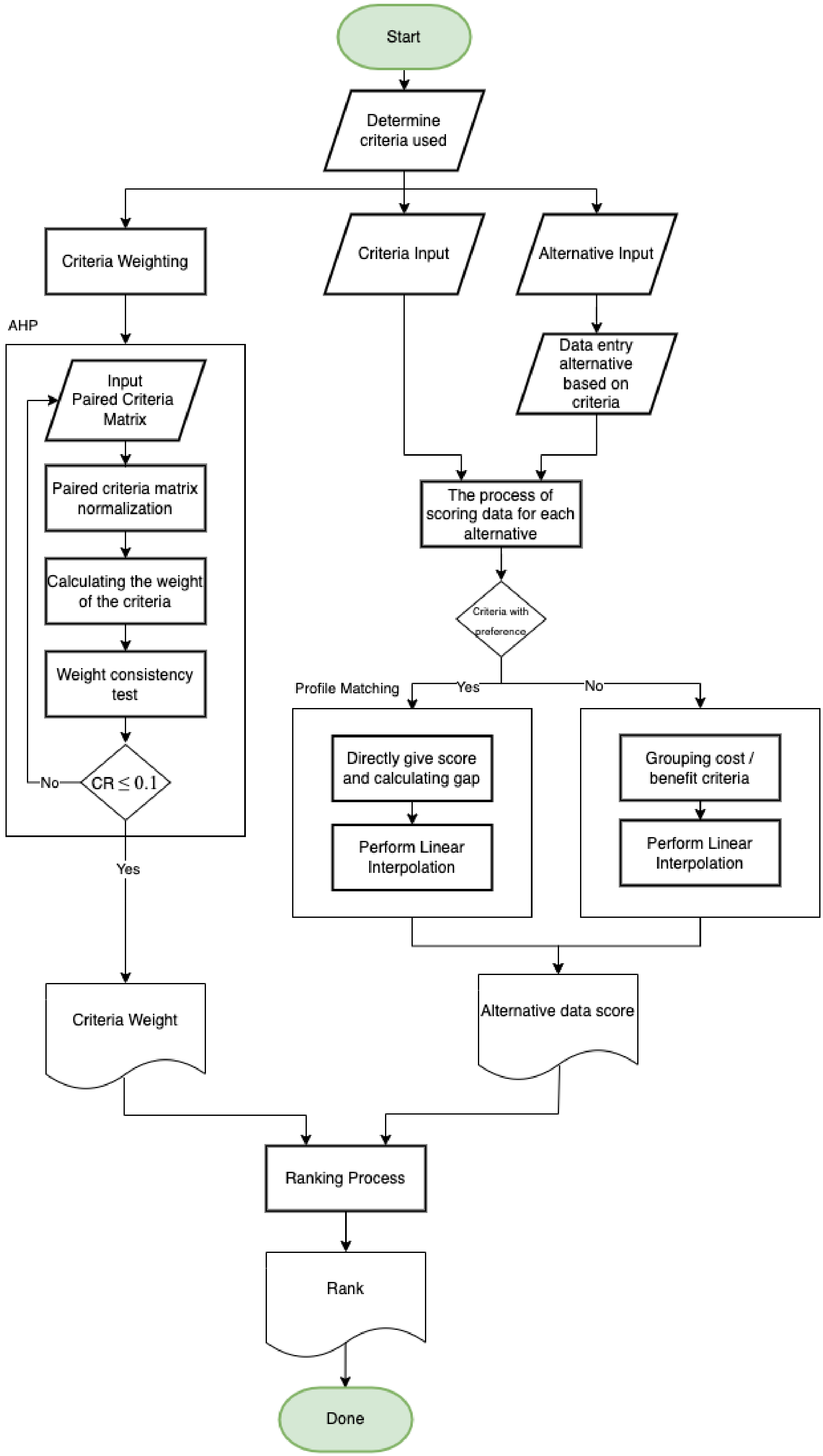

Figure 1 Diagram of using AHP Method and Profile Matching

2.2 AHP Method

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making technique that aims to deal with rational and intuitive problems in determining the best alternative among a number of alternatives [4]. Comparisons can be based on actual measurements, or on a fundamental scale that shows the strength of the relative preferences between elements. The following is the Saaty fundamental scale shown in Table 3 [4].

Table 1 Saaty fundamental scale

Intensity of importance	Definition
1	Both criteria are equally important.
3	One criteria is slightly more important.
5	One criteria is more important.
7	One criteria is strongly more important.
9	One criteria is absolutely more important.
2, 4, 6, 8	Values between the two adjacent judgements.
Reciprocal	If criterion i is assigned with one of the value above when compared to criterion j, then criterion j has the reciprocal value when compared to criterion i.

In the AHP method, the first step is to make a pairwise comparison matrix based on the fundamental scale of the time.

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} \tag{1}$$

The next step is to normalize the pairwise comparison matrix using the following equation.

$$r_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \tag{2}$$

$$R = \begin{bmatrix} r_{11} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{n1} & \cdots & r_{nn} \end{bmatrix} \tag{3}$$

Next, determine the priority weight by adding up the value of each row, then dividing by the number of elements.

$$w_i = \frac{\sum_{j=1}^{n} r_{ij}}{n} \tag{4}$$

After getting the AHP weights, the next step is to check the consistency of the weights (Consistency Ratio / CR). To get the CR value, first calculate the WSV value by adding up the multiplication of each row in the unnormalized pairwise comparison matrix with the priority weights of each element concerned.

$$s_{ij} = a_{ij} w_j \tag{5}$$

$$WSV_i = \sum_{j=1}^{n} s_{ij} \tag{6}$$

Then calculate the Consistency Vector / CV value by dividing the WSV by the priority weight of the appropriate element.

$$CV_i = \frac{WSV_i}{w_i} \tag{7}$$

Then calculate the maximum eigenvalue (λmax) by dividing the number of CV by the number of elements.

$$\lambda_{max} = \frac{\sum_{i=1}^{n} CV_i}{n} \tag{8}$$

Then calculate the Consistency Index value, and with the following equation.

$$\mathrm{CI} = \frac{\lambda_{max} - n}{n-1} \tag{9}$$

Then calculate the Consistency Ratio with the following equation.

$$\mathrm{CR} = \frac{\mathrm{CI}}{RC} \tag{10}$$

RC stands for Random Consistency, where its value depends on the size of the matrix, or the number of elements being compared. RC values can be seen in Table 2

Table 2 Random Consistency (RC)

Size of Matrix	Value
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56
14	1.57
15	1.59

The AHP weight is considered consistent if it has a CR value of less than or equal to 10%, if it is more then it is considered inconsistent.

2.3 Profile Matching Method

Profile Matching is a decision-making mechanism by assuming that there is an ideal level of predictor variables that applicants must have, not a minimum level that must be passed [2]. The assessment process in the Profile Matching method can be done by assigning a direct value to the desired target, or by calculating the gap (difference between data and target). The smaller the gap, the higher the value. The steps in the Profile Matching method using the value gap are as follows:

1. Calculating the Gap value by finding the difference between the attribute/data value and the target value.

$$\text{Gap} = \textit{atribut value} - \textit{target value} \quad (11)$$

2. Give weight to the Gap value that has been obtained on each criterion with the values contained in Table 3 below.

Table 3 Gap value weight

No	Gap Difference	Value Weight	Description
1.	0	10	No difference
2.	1	9.5	1 level of excess criteria
3.	-1	9	1 level deficiency criteria
4.	2	8.5	2 level of excess criteria
5.	-2	8	2 level deficiency criteria
6.	3	7.5	3 level of excess criteria
7.	-3	7	3 level deficiency criteria
8.	4	6.5	4 level of excess criteria
9.	-4	6	4 level deficiency criteria
10.	5	5.5	5 level of excess criteria
11.	-5	5	5 level deficiency criteria
12.	6	4.5	6 level of excess criteria
13.	-6	4	6 level deficiency criteria
14.	7	3.5	7 level of excess criteria
15.	-7	3	7 level deficiency criteria
16.	8	2.5	8 level of excess criteria
17.	-8	2	8 level deficiency criteria
18.	9	1.5	9 level of excess criteria
19.	-9	1	9 level deficiency criteria

3. Or perform linear interpolation by determining the maximum and minimum values.

2.4 Interpolasi Linear

Linear Interpolation is to determine the points between two points using a straight line function approach. In determining the Linear Interpolation equation, it can be done through a straight line equation that passes through two points P1 (X0, Y0) and P2 (X1, Y1) can be written as [5]:

$$\frac{y - y_0}{y_1 - y_0} = \frac{x - x_0}{x_1 - x_0} \tag{12}$$

So that the equation of Linear Interpolation is obtained as follows:

$$y = \frac{y_1 - y_0}{x_1 - x_0}(x - x_0) + y_0 \tag{13}$$

Description:
y = point value to be searched
y1 = upper limit
y0 = lower limit
x1 = upper limit of range
x0 = lower limit of range

3. RESULTS AND DISCUSSION

3.1 Dataset

The data in this study are keyboard data available in Indonesia taken from the Indonesian mechanical keyboard discussion forum on Facebook called the Indonesia Mechanical Keyboard Group. Incomplete data must be completed first by taking information from online buying and selling sites and the official keyboard brand website. Mechanical keyboard data and its specifications are stored in hard code into a table as shown in Figure 2 below.

No.	Name	Layout	Price	PCB type	Switch	Connectivity	Case colour	Case material
1	Digital Alliance Meca Sport-linear	0,6	477.000	hotswap	linear	detachable	hitam	metal
2	Digital Alliance Meca Sport-tactile	0,6	477.000	hotswap	tactile	detachable	hitam	metal
3	Vortexseries VX5-linear black	0,6	350.000	hotswap	linear	detachable	hitam	plastik
4	Vortexseries VX5-tactile black	0,6	350.000	hotswap	tactile	detachable	hitam	plastik
5	Vortexseries VX5-clicky black	0,6	350.000	hotswap	clicky	detachable	hitam	plastik
6	Vortexseries VX5-linear white	0,6	350.000	hotswap	linear	detachable	putih	plastik
7	Vortexseries VX5-tactile white	0,6	350.000	hotswap	tactile	detachable	putih	plastik
8	Vortexseries VX5-clicky white	0,6	350.000	hotswap	clicky	detachable	putih	plastik
9	Vortexseries VX10-linear	fullsize	500.000	hotswap	linear	wired	hitam	plastik
10	Vortexseries VX10-tactile	fullsize	500.000	hotswap	tactile	wired	hitam	plastik
11	Vortexseries VX10-clicky	fullsize	500.000	hotswap	clicky	wired	hitam	plastik
12	Vortexseries VX8-linear	0,75	630.000	hotswap	linear	detachable	hitam	plastik
13	Vortexseries VX9-tactile	0,75	630.000	hotswap	tactile	detachable	hitam	plastik
14	Vortexseries VX10-clicky	0,75	630.000	hotswap	clicky	detachable	hitam	plastik
15	Imperion Mech 7-black	TKL	390.000	non-hotswap	tactile	wired	hitam	metal
16	Imperion Mech 7-grey	TKL	390.000	non-hotswap	tactile	wired	abuabu	metal
17	Magicforce MF68-linear black	0,65	850.000	hotswap	linear	detachable	hitam	plastik
18	Magicforce MF68-tactile black	0,65	850.000	hotswap	tactile	detachable	hitam	plastik
19	Magicforce MF68-clicky black	0,65	850.000	hotswap	clicky	detachable	hitam	plastik
20	Magicforce MF68-linear white	0,65	850.000	hotswap	linear	detachable	putih	plastik
21	Magicforce MF68-tactile white	0,65	850.000	hotswap	tactile	detachable	putih	plastik
22	Magicforce MF68-clicky white	0,65	850.000	hotswap	clicky	detachable	putih	plastik
23	Imperion Mech 10-black	fullsize	415.000	non-hotswap	tactile	wired	hitam	metal

Figure 2 Snip of mechanical keyboard data collection

3.2 Processing Results with AHP weighting, Profile Matching, and Linear Interpolation

After getting input from the user, the system then performs a weight calculation process using the AHP weighting method, followed by a scoring/assessment process using the Profile Matching method for criteria that require preference, and for criteria without preferences, the criteria grouping process is carried out as a cost or as a benefit. scoring is done using linear interpolation according to the type of criteria.

	Name	Layout	Price	PCB type	Switch	Connectivity	Case colour	Case material	Total value
0	Vortexseries VX5-linear black	0.6	350000	hotswap	linear	detachable	hitam	plastik	10.000000
1	Vortexseries VX5-linear white	0.6	350000	hotswap	linear	detachable	putih	plastik	9.564835
2	Vortexseries VX5-tactile black	0.6	350000	hotswap	tactile	detachable	hitam	plastik	9.339366
3	Digital Alliance Meca Sport-linear	0.6	477000	hotswap	linear	detachable	hitam	metal	9.308945
4	Vortexseries VX5-tactile white	0.6	350000	hotswap	tactile	detachable	putih	plastik	8.904202
5	Vortexseries VX5-clicky black	0.6	350000	hotswap	clicky	detachable	hitam	plastik	8.810860
6	Digital Alliance Meca Sport-tactile	0.6	477000	hotswap	tactile	detachable	hitam	metal	8.648311
7	Vortexseries VX5-clicky white	0.6	350000	hotswap	clicky	detachable	putih	plastik	8.375695
8	Vortexseries VX8-linear	0.75	630000	hotswap	linear	detachable	hitam	plastik	8.168855
9	Magicforce MF68 linear black	0.65	850000	hotswap	linear	detachable	hitam	plastik	8.044844

Figure 3 Example of spk result

3.3 System Testing Results

System testing was carried out by conducting a survey involving 10 respondents from a Facebook forum/discussion group called the Indonesia Mechanical Keyboard Group. respondents were asked to try the system, then fill out the assessment form that has been provided related to the evaluation of the decision support system that has been built.

Furthermore, the results of the assessment form, are used to find quantitative scores which will then be categorized in each aspect. According to Azwar (2012), categories and corresponding quantitative scores are shown in Table 4 below [6-10].

Table 4 Quantitative score range

Score	Category
$X \leq M{-}1.5SD$	Not very good
$(M{-}1.5SD) < X \leq ((M{-}0.5SD\ )$	Not good
$(M{-}0.5SD) < X \leq ((M{+}0.5SD)$	Moderate
$(M{+}0.5SD) < X \leq ((M{+}1.5SD)$	Good
$X > M{+}0.5SD$	Very good

X is the aspect score being calculated, which can be obtained by applying Equation 14. M is the average whose value is calculated using Equation 15. SD stands for Standard Deviation, where the value is obtained using Equation 16. $Xmax$ is the highest score for the statement, while $Xmin$ is the lowest score for the statement.

$$A = \frac{\sum Statement\ Score}{Number\ of\ Statements} \tag{14}$$

$$M = Average = \frac{Xmax + Xmin}{2} \tag{15}$$

$$SD = \frac{Xmax + Xmin}{6} \tag{16}$$

From the test results, obtained values for aspects of reliability 37, usability 35.5, and helpfulness 36, all of these results can be categorized into the very good category, which means the system can assist users in determining the choice of the desired mechanical keyboard. From the results of these scores, the average evaluation results for aspects of reliability, usability, and helpfulness are 36.17 out of a total maximum score of 40.

4. CONCLUSIONS

Based on the test results, the decision support system built is able to provide mechanical keyboard priority recommendations according to user preferences and get evaluation results for aspects of reliability 37, usability 35.5, and helpfulness 36, then the average evaluation result is 36.17 for all aspects of the maximum total value is 40.

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