

Simple Additive Weighting (SAW) Method to Provide Recommendations for Graphic Processing Unit (GPU) Selection

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Abstract

CV. Venes Jaya is a company that operates in the field of technological equipment such as computer hardware, monitors, recording equipment, communications equipment, networks, and many more. With the complete range of products sold and reliable teams, this company still has problems in providing recommendations for GPU selection to customers. This process is still carried out manually, namely by providing recommendations according to the funds owned by the customer. If there is more than one alternative that suits the funds owned by the customer, employees will have difficulty choosing them. Such a manual process is likely to be wrong or mistaken. Therefore, there is a need for innovation that can help and make it easier for employees to provide recommendations for GPU selection to customers, namely by implementing a Decision Support System (SPK) that uses the Simple Additive Weighting (SAW) method built with the VB programming language, and a MySQL database. In determining GPU recommendations that will be given to customers. This system is expected to help CV. Venes Jaya in providing GPU recommendations quickly, precisely and accurately. The results obtained from this research are that Alternative 5, namely the Gigabyte RTX 3080 Ti Gaming OC, was selected as the best alternative with a total value of 1. These results are the results obtained from the Decision Support System created by the author, where these results will be used as recommendations to customers in choosing Graphics . Processing Unit (GPU). This system can help CV. Venes Jaya in providing GPU recommendations to customers quickly, precisely and accurately.

Keywords : Decision Support Systems, Simple Additive Weighting (SAW), Alternative Graphic Processing Unit (GPU).

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1. Introduction

The development of technology today is extraordinary, as is the development of computer hardware, one of which is the Graphic Processing Unit (GPU). The Graphics Processing Unit or what is usually called a GPU was first introduced on August 31 1999 for the personal computer (PC) industry. The definition of a GPU is a single chip processor integrated with transformation, lighting, triangle arrangement, and capable of processing a minimum of 10 million squares per second. Current GPUs can manipulate textures and vertices with the same operations on the Central Processing Unit (CPU) and render colors with high precision [1].

Decision Support Systems are part of computer-based Information Systems, including knowledge-based systems (knowledge management) which are used to support decision making in an organization or company. Decision Support Systems are designed to support all stages of decision making starting from identifying problems, selecting relevant data, and determining the approach used in decision making, to evaluating alternative selection [2].

According to Nofriansyah, the Simple Additive Weighting method is often also known as the weighted addition method. The basic concept of Simple Additive

Weighting is to find the weighted sum of the performance ratings for each alternative on all attributes. The Simple Additive Weighting method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings [3]. Decision support systems are designed to support all stages of decision making starting from identifying problems, selecting relevant data, and determining the approach used in the decision making process to evaluating the selection of existing alternatives [4]. This method is a weighted determination, weighting is given to each criterion to obtain ranking results. The one with the highest value is the priority choice so that the selection and calculation of these criteria can be done quickly, precisely and closely to the criteria desired by the service user [5].

Visual Basic is an object-centered programming language (Object Oriented Programming) used in creating Windows applications based on the Graphical User Interface. This makes Visual Basic a programming language that every programmer must know and master. Some object characteristics cannot be carried out by Visual Basic, for example, Inheritance cannot be a module and limited Polymorphism can be done by declaring a class module that has a certain interface [6].

Previous research on the implementation of a decision support system using the SAW method in selecting the best teacher has found that A2 has the highest score among the two other alternatives. So from the case example above it can be concluded that the system using the SAW method has provided the best recommendation for Alternative 2 [7]. In comparative research on decision support systems using the SAW and WP methods in providing loans, results were obtained. The suitability level of the SAW method is 97.274% and the WP method is 99.80006%, thus the WP method is the most relevant method for solving loan granting problems [8]. There are many previous studies in other fields such as BLT acceptance in Sampan sub-district [9], housing selection [10], poor student assistance selection [11], laboratory assistant performance assessment [12] and many other studies.

A glance at the Venes Jaya shop, this shop is a shop that sells computer-related goods. Located on Jalan Hos. Cokroaminoto No.6, Pondok Village, West Padang, Padang City, West Sumatra. The problem in this shop which is the basis of this research is that manual methods are still used in providing recommendations for selecting Graphic Processing Units (GPU). The possibility of errors in providing recommendations made manually is quite large, for example errors in providing a GPU which does not match the customer's needs, and the recommended GPU exceeds the funds prepared by the customer.

Therefore, new innovations are needed to solve existing problems. By building a Decision Support System using the Simple Additive Weighting method in making decisions to provide GPU recommendations to customers, existing problems can be resolved

2. Research methodology

To help prepare this research so that the steps in solving the problem to be discussed can be arranged clearly, a framework structure is needed. The research framework is in Figure 1 below:

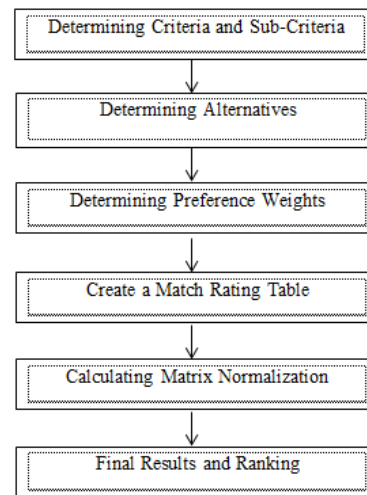


Figure 1. Research Framework

The Simple Additive Weighting (SAW) method is one of the techniques used in multi-criteria decision making. This method is used to evaluate and select alternatives based on a number of given criteria. Following are the steps in the SAW method:

1. **Determining Criteria and Sub-Criteria**
Criteria that will be used in decision making. These criteria must be relevant to the problem being faced and reflect the aspects you want to evaluate.
2. **Determining Alternatives**
Identify and detail all alternatives that will be evaluated in the decision-making context. Alternatives are options or solutions that can be chosen to solve a problem or achieve a certain goal.
3. **Determining Preference Weights**
Determining preference weights is an important step in the Simple Additive Weighting (SAW) method or in other multi-criteria decision making. Preference weight describes the extent to which each criterion is considered important or has different levels of preference in the decision-making process
4. **Create a Match Rating Table**
This table is used to assess the extent to which each alternative meets or is compatible with each criterion
5. **Perform Matrix Normalization**
Normalization is carried out to change the assessment matrix so that all values are on a uniform scale, thereby allowing a fair comparison between criteria or alternatives.
6. **Calculating Final Scores and Rankings**
Alternatives are based on weighting values that have been calculated from highest to lowest. The alternative with the highest weighting value will be the best choice according to the specified criteria.

According to Fishburn, the Simple Additive Weighting (SAW) method is a problem solving method. Which is often also known as the weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative from all attributes. The SAW method requires a process of normalizing the decision matrix (x) to a scale that can be compared with all existing alternative ratings [13]. Given the equation in the picture as follows:

$$rij (benefit) = \frac{xij}{\max xij}$$

$$rij (cost) = \frac{\min xij}{xij}$$

Where:

- rij = Normalized performance rating
- Max Xij = Maximum value of each row and column
- Min Xij = Minimum value of each row and column
- Xij = Rows and columns of the matrix
- Benefit = if the greatest value is the best
- Cost = if the smallest value is the best

Where rij is the normalized performance rating of alternative Ai on attribute Cj ; i = 1.2....m and j = 1.2....n. The preference value for each alternative (Vi) is given in the figure as follows:

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

Information:

- Vi = Preference value
- wj = Ranking weight
- rij = normalized performance rating

larger Vi value indicates that alternative Ai is more selected.

3. Results and Discussion

3.1 Simple Additive Weighting (SAW) Calculation

The calculation uses the *Simple Additive Weighting* (SAW) method, where this calculation will be applied to the application to be created. The weights of the criteria used in the calculations can be seen in Table 1 below:

Table 1. Criteria and Weights

No	Criteria Code	Criteria	Weight (%)
1	C1	Price	40
2	C2	Core Clock	30
3	C3	VRAM	20
4	C4	Memory Clock	10

From the table above it can be seen that there are 4 criteria, namely, Price, Core Clock, VRAM and

Memory Clock criteria. Where each criterion is given a weight. Next, we will see an alternative table that will be used in the following research:

Table 2. Alternative Table

Alternative	Price	Core Clock (mhz)	VRAM (Gb)	Memory Clock (mhz)
Colorful GTX 1050	3200000	1291	4	7000
MSI GTX 1060	7000000	1860	6	12000
Inno 3D RTX 3060	8900000	1320	12	15000
Asus RTX 3060	14000000	1890	8	14000
Gigabyte RTX 3080	30000000	1710	12	19000

In this calculation, *the cost* is price (C1), and the *benefits* are *core clock* (C2) , VRAM (C3), and *memory clock* (C4) .

Then the author converts each value of the alternative. The converted values are price (C1), *core clock* (C2) , VRAM (C3), and *memory clock* (C4) . The following are the results of the conversion carried out:

1. Price value conversion

The price criterion is an assessment of the low price of the GPU which is profitable for customers in the *cost category* .

Table 3. Value Conversion Table

Criteria	Mark	Weight
Price	0-5000000	4
	6000000-10000000	3
	11000000-20000000	2
	21000000-50000000	1
Core Clock	0-1300mhz	1
	>1300-1500 mhz	2
	>1500-2000 mhz	3
VRAM	0-4GB	1
	>4-6GB	2
	>6-8GB	3
	>8-12	4
Memory Clock	0-5000mhz	1
	>5000-10000	2
	>10000-15000 mhz	3
	>15000 mhz	4

Then, after converting each alternative value, the value of each alternative is determined. The following are the values of each alternative:

Table 4. Value of Each Alternative

Alternative	Criteria			
	C1	C2	C3	C4
A1	4	1	1	2
A2	3	3	2	3
A3	3	2	4	3
A4	2	3	3	3
A5	1	3	4	4

After each alternative is given a value, the next step is to normalize each alternative value that was previously created. Here is the normalization:

$$r_{11} = \frac{\min(4;3;3;2;1)}{4} = \frac{1}{4} = 0.25$$

$$r_{21} = \frac{\min(4;3;3;2;1)}{3} = \frac{1}{3} = 0.3333$$

$$r_{31} = \frac{\min(4;3;3;2;1)}{3} = \frac{1}{3} = 0.3333$$

$$r_{41} = \frac{\min(4;3;3;2;1)}{2} = \frac{1}{2} = 0.5$$

$$r_{51} = \frac{\min(4;3;3;2;1)}{1} = \frac{1}{1} = 1$$

$$r_{12} = \frac{1}{\max(1;3;2;3;3)} = \frac{1}{3} = 0.3333$$

$$r_{22} = \frac{3}{\max(1;3;2;3;3)} = \frac{3}{3} = 1$$

$$r_{32} = \frac{2}{\max(1;3;2;3;3)} = \frac{2}{3} = 0.6666$$

$$r_{42} = \frac{3}{\max(1;3;2;3;3)} = \frac{3}{3} = 1$$

$$r_{52} = \frac{3}{\max(1;3;2;3;3)} = \frac{3}{3} = 1$$

$$r_{13} = \frac{1}{\max(1;2;4;3;4)} = \frac{1}{4} = 0.25$$

$$r_{23} = \frac{2}{\max(1;2;4;3;4)} = \frac{2}{4} = 0.5$$

$$r_{33} = \frac{4}{\max(1;2;4;3;4)} = \frac{4}{4} = 1$$

$$r_{43} = \frac{3}{\max(1;2;4;3;4)} = \frac{3}{4} = 0.75$$

$$r_{53} = \frac{4}{\max(1;2;4;3;4)} = \frac{4}{4} = 1$$

$$r_{14} = \frac{2}{\max(2;3;3;3;4)} = \frac{2}{4} = 0.5$$

$$r_{24} = \frac{3}{\max(2;3;3;3;4)} = \frac{3}{4} = 0.75$$

$$r_{34} = \frac{3}{\max(2;3;3;3;4)} = \frac{3}{4} = 0.75$$

$$r_{44} = \frac{3}{\max(2;3;3;3;4)} = \frac{3}{4} = 0.75$$

$$r_{54} = \frac{4}{\max(3;3;3;3;4)} = \frac{4}{4} = 1$$

The results of the normalization above are as follows:

$$r = \begin{bmatrix} 0.25 & 0.3333 & 0.25 & 0.5 \\ 0.3333 & 1 & 0.5 & 0.75 \\ 0.3333 & 0.6666 & 1 & 0.75 \\ 0.5 & 1 & 0.75 & 0.75 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

The next step is to determine the preference value, namely the process of multiplying the normalization matrix value multiplied by the weight value. The weight values that have been determined are as follows:

$$w = [0.40, 0.30, 0.20, 0.10]$$

So the results obtained are as follows:

$$v_1 = (0.40)(0.25) + (0.30)(0.3333) + (0.20)(0.25) + (0.10)(0.15) = 0.29999$$

$$v_2 = (0.40)(0.3333) + (0.30)(1) + (0.20)(0.5) + (0.10)(0.75) = 0.55832$$

$$v_3 = (0.40)(0.3333) + (0.30)(0.6666) + (0.20)(1) + (0.10)(0.75) = 0.6083$$

$$v_4 = (0.40)(0.5) + (0.30)(1) + (0.20)(0.75) + (0.10)(0.75) = 0.725$$

$$v_5 = (0.40)(1) + (0.30)(1) + (0.20)(0.25) + (0.10)(1) = 1$$

After obtaining the preference values above, the final step is to determine the ranking values which are presented in table form below:

No	Alternative	Preference Value	Rank
1	A1	0.29999	5
2	A2	0.55832	4
3	A3	0.6083	3
4	A4	0.725	2
5	A5	1	1

Based on the ranking values above, it can be concluded that the largest value is V5, so alternative A5 is the alternative chosen as the best alternative. In other words, the Gigabyte RTX 3080 Ti Gaming OC (A5) will be selected as the Graphic Processing Unit (GPU) that will be recommended to customers

3.2 System Testing

Main page

This page is the first page seen by the user.

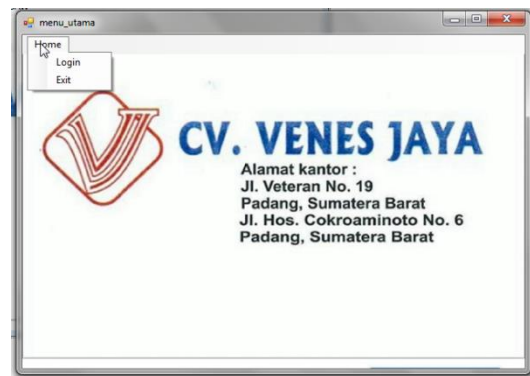


Figure 2 . Main page

Form Login

This page is a page where the system validates *users* who want to use the system.

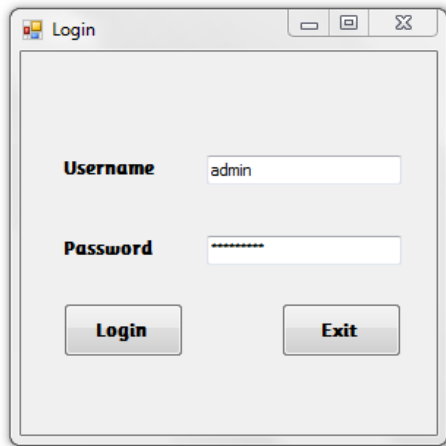


Figure 3 . Login Form

GPU Data Input Page

This page is the page where *the admin* enters GPU data, which data will be used as calculation material for this system.

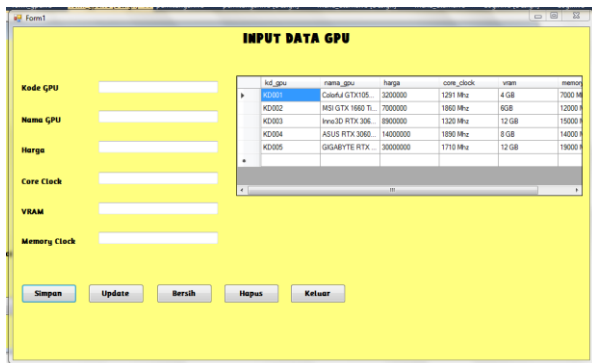


Figure 4 . GPU Data Input

Input Weight Data

This page is a page where the admin enters weight data consisting of price, *core clock* , *VRAM*, and *memory clock* .

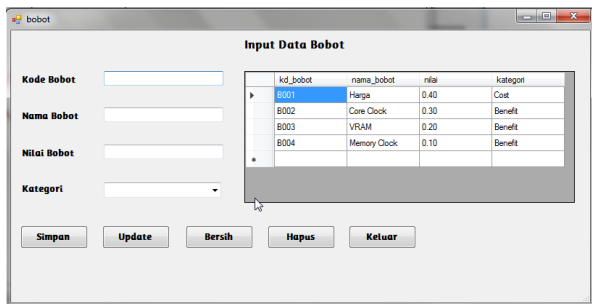


Figure 5 . Input Weight Data

Alternative Assessment Data Input

This page is a page where the admin enters assessment data for each available alternative.

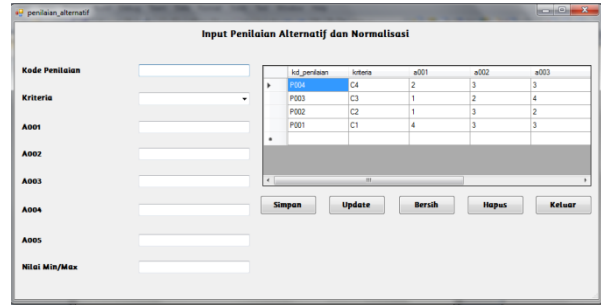


Figure 6 . Alternative Assessment Data Input

Normalization Page

On this page, employees will carry out a normalization process through the system before carrying out calculations to determine ranking.

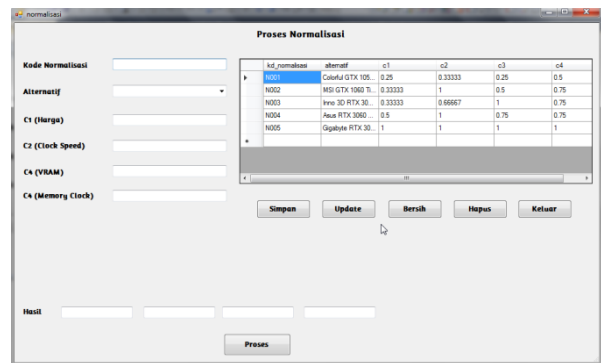


Figure 7 . Normalization Page

SAW Calculation Page

On this page, employees will perform calculations through the system to determine which GPU is the best GPU to recommend to customers.

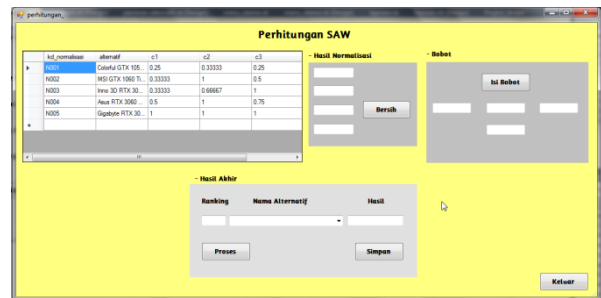


Figure 8 . SAW Calculation Page

4. Conclusion

After designing a Decision Support System (SPK), Venes Jaya Store can be helped in making decisions quickly to provide recommendations for sales of Graphic Processing Units (GPU) to customers, the system can analyze decision data to recommend sales of Graphic Processing Units (GPU) to customers quickly and accurate. By using the Visual Basic (VB) programming language used in processing decision-making data, the system can recommend Graphic Processing Unit (GPU) sales to customers quickly and accurately.

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