Decision Support System for Selecting a Camera Stabilizer Using Rank Reciprocal and ARAS Approaches

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Abstract—The selection of camera stabilizers is a crucial aspect in the photography and videography industry, especially with the increasing use of cameras. Typically, to select a camera stabilizer, decision-makers must be aware of all specifications of the available options. However, this necessarily results in a lengthy decision-making process, and various considerations lead to imprecise decisions. The aim of our research is to develop a Decision Support System (DSS) for choosing the appropriate and swift camera stabilizer through a combination of the Rank Reciprocal weighting approach and the Additive Ratio Assessment (ARAS) method. The Rank Reciprocal approach is utilized to obtain the criteria weight values, and the ARAS method is employed to evaluate and select the best alternative based on a number of criteria. This research produced a website-based DSS that can recommend the best alternative in the form of an alternative ranking. The results from the case study conducted obtained rankings from the highest to the lowest as follows: Zhiyun Tech Weebill S with a score of 0.9428, Beholder DS1 with a score of 0.8497, Gudsen Moza AirCross S with a score of 0.8205, and Feiyu Tech Scorp C (A3) with a score of 0.7197. The system built has been tested with a usability test scoring 88.75%, indicating that the system has met its users’ needs.

Keywords: Additive Ratio Assessment; ARAS; Camera Stabilizer; Decision Support Systems; Rank Reciprocal

1. INTRODUCTION

In the contemporary digital age, the utilization of cameras for personal or professional needs has become widespread. This is especially notable given the increasing prevalence of digital content, including photography, videography, and social media, leading to a rising demand for enhanced image and video quality [1]. One crucial factor influencing the final outcome of capturing images or videos is camera stability. A camera stabilizer is a device designed to reduce vibrations or shakes caused by hand movements or other motions during the process of capturing images or videos [2]. The utilization of a camera stabilizer can significantly enhance the overall quality by providing smoother and more stable images or videos [3]. However, with various types and brands of camera stabilizers available in the market, selecting the most suitable one for users’ needs can be a challenging task. Typically, to make an informed decision, the decision-maker must be acquainted with all the specifications of the available options. They then need to align these specifications with their criteria or preferences based on their specific requirements. However, this process can lead to a prolonged decision-making period, and various considerations may result in an inaccurate decision. Additionally, the abundance of factors to consider in decision-making makes the process more challenging, especially for those lacking experience in this field. Hence, a solution for the development of a system that can quickly, easily, and accurately recommend camera stabilizers is essential.

Previous research on the development of decision support systems related to camera devices has been conducted using various methods. Sari & Palumpun’s (2021) research, for example, involved developing software to choose the best camera using the Simple Multi Attribute Technique (SMART) method [4]. The approach employed yields the best alternatives by focusing on evaluating several interrelated attributes or criteria. Subsequent research conducted by Purnomo & Gunawan (2022) delved into the implementation of the Simple Additive Weighting (SAW) approach for selecting cameras [5]. The SAW approach can select alternatives based on the summation of weights assigned to each criterion. Subsequently, research conducted by Saragih et al. (2023) focused on the development of a system for choosing DSLR cameras using the Analytical Hierarchy Process (AHP) method [6]. The method employed obtains the best options through the formation of a pairwise comparison matrix. Subsequently, calculations are performed to derive the eigenvector and eigenvalue from this pairwise comparison matrix. Another study conducted by Baizura et al. (2023) focused on a decision support system for determining the best camera using the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method [7]. This method is capable of obtaining the best alternatives by combining the concept of proximity with positive and negative ideal solutions to determine the relative ranking of each alternative. In the subsequent study, the development of a system for selecting IP cameras was conducted by applying the Composite Performance Index (CPI) method [8]. The mentioned method is utilized to integrate various performance indicators or relevant criteria to provide a holistic overview of the efficiency and effectiveness of an entity.

The proposed research differs by focusing on a case study for selecting a camera stabilizer and combining the Rank Reciprocal weighting approach with the Additive Ratio Assessment (ARAS) method. In the decision-
making process, the importance of criterion weights cannot be overlooked, as they play a significant role in establishing the priority of each criterion. These criterion weights have a substantial impact on identifying the most suitable alternatives [9]. However, decision-makers sometimes encounter difficulties in assigning specific values to these weights. Therefore, a method or approach that facilitates decision-makers in establishing criterion weights more effectively is needed. The Rank Reciprocal method is a weighting technique used in decision support systems to assess and rank alternatives or options based on specific criteria [10]. The main concept of this method involves assigning weights to each criterion based on their rankings within each criterion. These weights are inversely proportional to their rankings [11]. Meanwhile, the method used to generate the best alternatives employs the ARAS approach. The Additive Ratio Assessment (ARAS) method is a technique in decision support systems used to evaluate and select the best alternatives based on predefined criteria [12]. The primary advantage of the ARAS method lies in its ability to comprehensively integrate various evaluation criteria, enabling decision-makers to consider diverse aspects when evaluating alternatives [13]. Thus, this method focuses on calculating the relative efficiency ratios of each alternative compared to the ideal alternative, determined based on the optimal values of each criterion.

The goal of this research is to construct a decision support system for selecting the right camera stabilizer efficiently through the combination of the Rank Reciprocal weighting approach and the Additive Ratio Assessment (ARAS) method. The developed decision support system is web-based to facilitate easy access and is equipped with recommendations in the form of alternative rankings to support accuracy and speed in decision-making.

2. RESEARCH METHODOLOGY

2.1 Research Stages

The research stages provide a structured guide that directs researchers throughout the research process, starting from problem identification to conclusion drawing [14]. This research process is graphically represented in Figure 1.

![Figure 1. Research Procedures Applied](image)

The research procedure, as depicted in Figure 1, is elaborated in detail as follows:

1) Problem Identification

   The identification of problems represents the initial stage in the problem-solving process, wherein the aim is to identify and formulate the issues or challenges that need to be addressed [15]. To ascertain the primary issues in the case of selecting a camera stabilizer, interviews and observations are conducted. Based on the interviews and observations, it is evident that in order to make a decision about selecting a camera stabilizer, decision-makers must be acquainted with all the specifications of the available options. Subsequently, they need to align these specifications with their criteria or preferences according to their needs. However, this process inevitably leads to a prolonged decision-making duration and, with various considerations, may result in inaccurate decisions. Furthermore, the multitude of considerations involved in decision-making renders the process more arduous, especially for those with limited experience in this field. Therefore, there is a need for the development of a system solution that can facilitate recommending camera stabilizers quickly, easily, and accurately.

2) Collecting Criteria and Alternative Data

   (continued)
The criteria and alternatives are two key elements that provide the foundation for a structured and informed decision-making process [16]. Criteria are parameters or factors used to evaluate and compare the available options. On the other hand, alternatives refer to various options or solutions that can be chosen or adopted to meet a specific goal or need. The criteria used refer to an article written by experts on the MyBest website [17]. The criteria considered involve factors such as Compatible Devices, Battery Life, Maximum Load, Price, and Number of Axes. Meanwhile, the alternatives used in this case study are the Beholder DS1, Zhiyun Tech Weebill S, Feiyu Tech Scorp C, and Gudsen Moza AirCross S.

3) Setting Criteria Weights with Reciprocal Rank

The determination of criterion weights, representing the relative importance of criteria, holds significant importance in the decision-making process. These weights are established by decision-makers according to the perceived degrees of importance assigned to each criterion. However, not all decision-makers can clearly determine the weight of each criterion. To facilitate the determination of decision weights, the Rank Reciprocal approach is used. The Rank Reciprocal approach allows users to rank these criteria hierarchically based on their levels of importance [11]. Subsequently, relative weights are assigned by leveraging reciprocal relationships among the rankings. These weights reflect the extent to which a criterion is more important than others.

4) Determining the Best Alternative Using the ARAS Method

The Additive Ratio Assessment (ARAS) method is an approach in Decision Support Systems (DSS) used to address complexity in the decision-making process by considering various criteria and alternatives. This method involves calculating relative decision scores for each alternative based on comparisons to the criteria. The basic principle of ARAS is to assign weights to criteria and alternatives, which are then summed to determine the total score value for each alternative [13]. Thus, at this stage, the output consists of recommendations for the best alternative based on the ARAS approach.

5) Coding the System

System coding refers to the process of implementing system designs into appropriate programming languages [18]. This involves writing program code that encompasses the functionality designed in the system design phase. In this research, the decision support system is developed based on a website using the RapidPHP Editor code editor and MySQL database.

6) Testing the System

System testing is a critical stage in the software development cycle aimed at ensuring that the system meets the requirements and needs of users [19]. In this paper, the Usability testing approach is employed to determine if the developed software meets user needs. Usability testing is an evaluation method used to assess the extent to which a product or system can be effectively, efficiently, and satisfactorily used by users [20]. This testing refers to the usability elements defined in ISO 9126, which include sub-criteria such as understandability, learnability, operability, and attractiveness. In this study, a questionnaire is prepared and then filled out by users to gather assessments related to the usability of the developed decision support system.

2.2 Rank Reciprocal Approach

The Rank Reciprocal method is a weighting technique used in decision support systems to assess and rank alternatives or options based on specific criteria [21]. The main concept of this method is to assign weights to each criterion based on its rank, where the weight is the reciprocal of the rank [11]. For example, if an alternative ranks first in a criterion, the weight assigned is 1 (the reciprocal of rank 1); if it ranks second, the weight is 1/2, and so on. Thus, alternatives with higher ranks will receive higher weights, indicating higher priority or preference compared to other alternatives in that criterion [22]. To calculate the weighting through the implementation of the Rank Reciprocal method, it can be done by applying equation (1).

\[ w_j = \frac{1/j}{\sum_{k=1}^{k} 1/k} \]  

where \( w_j \) refers to the weight value of the criteria, \( j \) shows the ranking of the criteria, and \( k \) is the ranking order.

2.3 Additive Ratio Assessment (ARAS) Method

Decision Support System (DSS) is a system designed to assist decision-making by providing information, data analysis, and decision processing support [23]. The Additive Ratio Assessment (ARAS) method is an approach in decision support systems used to evaluate and select the best alternative based on multiple criteria [12]. This method focuses on forming a utility function that integrates all assessment criteria for each alternative in an additive manner [24]. The core of the ARAS method lies in calculating utility scores for each alternative by computing the ratio of the sum of the product of criterion weights and the performance values of each alternative to the ideal or optimal values that can be achieved [25]. The ARAS method is highly useful in multi-criteria decision-making as it can efficiently handle various types and numbers of criteria, and provides a systematic and
easily understandable way to compare and evaluate alternatives based on decision-maker preferences. The steps in the calculation of the ARAS method consist of several phases, as follows:

1) Determining criterion values, weights, alternatives, and optimum values.

This process begins by establishing relevant criteria, identifying the level of importance or weights for each criterion, and determining the alternatives to be evaluated. Next, the optimum values for each attribute are determined. Determining the optimum value \( X_{oij} \) involves consideration of the criterion type, which can be either benefit or cost. Benefit criteria emphasize maximum value, while cost criteria emphasize minimum value. Equation (2) is used for benefit criteria, while equation (3) is used for cost criteria.

\[
X_{oij} = \frac{\text{Max}}{1} \quad \text{(2)}
\]

\[
X_{oij} = \frac{\text{Min}}{1} \quad \text{(3)}
\]

where \( X_{oij} \) denotes the optimum value of criterion \( j \).

2) Creating the initial decision matrix.

The decision matrix is constructed by including all attributes, including the optimum values obtained in the previous stage. The decision matrix is formed following equation (4).

\[
X = \begin{bmatrix}
X_{01} & X_{0j} & \cdots & X_{0n} \\
X_{11} & X_{1j} & \cdots & X_{1n} \\
\vdots & \vdots & \ddots & \vdots \\
X_{n1} & X_{mj} & \cdots & X_{mn}
\end{bmatrix} \quad \text{(4)}
\]

where \( m \) is denoted as the number of options, and \( j \) is the criteria row.

3) Normalizing attributes and arranging them in a normalized matrix.

At this stage, normalization is performed for each attribute to ensure uniform assessment across all attributes. The normalized results are then arranged into a normalized matrix. Normalization is conducted according to the criterion type, where benefit criteria follow equation (5), while cost criteria also follow equation (6).

\[
x_{ij} = \frac{x_{ij}}{\sum_{j=1}^{m} x_{ij}} \quad \text{(5)}
\]

\[
x_{ij} = \frac{1}{x_{ij}}; x_{ij} = \frac{x_{ij}}{\sum_{j=1}^{m} x_{ij}} \quad \text{(6)}
\]

where \( x_{ij} \) denotes the \( i \)-th normalization value on criterion \( j \).

4) Forming weighted normalization and arranging it into a weighted normalized matrix.

At this stage, weighted normalization is performed to form the weighted normalized matrix. The attributes that have been normalized will be multiplied by their weights in this process, and this step is implemented using equation (7).

\[
D_{ij} = x_{ij} \times w_{ij} \quad \text{(7)}
\]

where \( D_{ij} \) denotes the \( i \)-weighted normalized value on criterion \( j \), \( x_{ij} \) refers to the \( i \)-th normalized value on criterion \( j \), and \( w_{ij} \) is the \( i \)-weighted weight on criterion \( j \).

5) The next step is to obtain the optimal value for each attribute.

Subsequently, the optimum values are determined through calculations using equation (8).

\[
S_i = \sum_{j=1}^{m} D_{ij} \quad \text{(8)}
\]

where \( S_i \) refers to the optimum value for alternative \( i \).

6) Acquiring the utility values of each attribute.

After obtaining the values of \( S_i \), the next step is to use these values as references to calculate the utility values for each criterion. These utility values serve as the basis for determining the best alternative, with the highest value being the optimal choice. The calculation of utility values can be performed using equation (9).

\[
K_i = \frac{S_i}{S_0} \quad \text{(9)}
\]

where \( K_i \) is the utility value for alternative \( i \), \( S_i \) and \( S_0 \) show the optimum value of each alternative.

3. RESULT AND DISCUSSION

To address the decision-making challenge in choosing a camera stabilizer, the initial step is to establish criteria that will serve as the basis for decision-making. These criteria refer to the article written by experts on the MyBest website [17]. The criteria considered involve factors such as Compatible Devices, Battery Life, Maximum Load, Price, and Number of Axis. Based on these criteria, their weight values are determined. These weights serve as
indicators of the relative importance attributed to each criterion. Additionally, each criterion also has a type, namely benefit and cost criteria. Benefit criteria prioritize higher values, whereas cost criteria prioritize lower values. To facilitate decision-makers in determining the weight of each criterion, the Rank Reciprocal approach is used. This approach focuses on the rankings given to each element in the ranking list. In Rank Reciprocal, the relevance or significance of an element is measured by considering the reciprocal of its ranking. To derive weights using the Rank Reciprocal approach, an initial ranking is assigned to each criterion, a task typically undertaken by the decision maker according to the priority of the criteria utilized. In this case study, the ranking criteria used are shown in Table 1.

**Table 1. Priority Ranking of Criteria Used**

<table>
<thead>
<tr>
<th>Code</th>
<th>Criterion Name</th>
<th>Type Criteria</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Compatible Devices</td>
<td>Benefit</td>
<td>1</td>
</tr>
<tr>
<td>C2</td>
<td>Battery Life</td>
<td>Benefit</td>
<td>2</td>
</tr>
<tr>
<td>C3</td>
<td>Maximum Load</td>
<td>Benefit</td>
<td>3</td>
</tr>
<tr>
<td>C4</td>
<td>Price</td>
<td>Cost</td>
<td>4</td>
</tr>
<tr>
<td>C5</td>
<td>Number of Axis</td>
<td>Benefit</td>
<td>5</td>
</tr>
</tbody>
</table>

In Table 1, a hierarchy of priorities or significance levels is presented for each criterion that forms the basis for estimating weights using the Rank Reciprocal method. To determine the weight values for each criterion, the calculation steps are executed using equation (1). Below are the stages of the calculation process:

\[
w_1 = \frac{1}{\frac{1}{4} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}} = 0.4380
\]

\[
w_2 = \frac{1}{\frac{1}{4} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}} = 0.2190
\]

\[
w_3 = \frac{1}{\frac{1}{4} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}} = 0.1460
\]

\[
w_4 = \frac{1}{\frac{1}{4} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}} = 0.1095
\]

\[
w_5 = \frac{1}{\frac{1}{4} + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}} = 0.0876
\]

After calculating the weight values using the Rank Reciprocal method for each criterion, the next step is to input these values into the table, as shown in Table 2.

**Table 2. Weights Resulting from the Rank Reciprocal Approach**

<table>
<thead>
<tr>
<th>Code</th>
<th>Criterion Name</th>
<th>Type Criteria</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Compatible Devices</td>
<td>Benefit</td>
<td>0.4380</td>
</tr>
<tr>
<td>C2</td>
<td>Battery Life</td>
<td>Benefit</td>
<td>0.2190</td>
</tr>
<tr>
<td>C3</td>
<td>Maximum Load</td>
<td>Benefit</td>
<td>0.1460</td>
</tr>
<tr>
<td>C4</td>
<td>Price</td>
<td>Cost</td>
<td>0.1095</td>
</tr>
<tr>
<td>C5</td>
<td>Number of Axis</td>
<td>Benefit</td>
<td>0.0876</td>
</tr>
</tbody>
</table>

Table 2 illustrates the criterion weight values obtained through the Rank Reciprocal method. Following the establishment of these criterion weights, the subsequent step involves defining the value ranges and executing the conversion for each designated criterion. Table 3 lists the values and conversions for each criterion.

**Table 3. Range of Criteria Values and Conversion Values**

<table>
<thead>
<tr>
<th>Criteria Code</th>
<th>Criterion Name</th>
<th>Criterion Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Compatible Devices</td>
<td>Mirrorless (1 Device)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirrorless, DSLR Camera (2 Device)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirrorless, DSLR Camera, Action Cam (3 Device)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirrorless, DSLR Camera, Action Cam, Smartphone (4 Device)</td>
<td>4</td>
</tr>
<tr>
<td>C2</td>
<td>Battery Life</td>
<td>&lt; 10 hours</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 10 hours and &lt; 12 hours</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 12 hours and &lt; 14 hours</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 14 hours</td>
<td>4</td>
</tr>
<tr>
<td>C3</td>
<td>Maximum Load</td>
<td>&lt; 1,500 grams</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 1,500 grams and &lt; 2,000 grams</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 2,000 grams and &lt; 2,500 grams</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 2,500 grams</td>
<td>4</td>
</tr>
<tr>
<td>C4</td>
<td>Price</td>
<td>&lt; 3,000,000</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;= 3,000,000 and &lt; 4,000,000</td>
<td>2</td>
</tr>
</tbody>
</table>
can be explained as follows: for cost criteria, equation (6) is employed. The computational process to obtain normalization for each attribute (there are 3 benefit criteria, namely C1, C2, and C4, and 1 cost criterion, namely C3. Therefore, the optimal values (x0) are generated as follows: {4; 4; 4; 2; 4}. All attribute values and optimal values are then integrated into the decision matrix. Normalization for benefit criteria utilizes equation (5), whereas if the criterion is a cost, equation (3) is used. In this context, there are 3 benefit criteria, namely C1, C2, and C4, and 1 cost criterion, namely C3. Therefore, the optimal values (x0) are generated as follows: {4; 4; 4; 2; 4}. All attribute values and optimal values are then integrated into the decision matrix following the guidelines of equation (4). Below are the results of the initial decision matrix:

\[
X = \begin{bmatrix}
4 & 4 & 4 & 2 & 4 \\
3 & 4 & 4 & 3 & 4 \\
2 & 3 & 4 & 2 & 4 \\
4 & 2 & 2 & 2 & 4
\end{bmatrix}
\]

After constructing the decision matrix, the next step is to perform normalization for each attribute and organize them into a normalized decision matrix. Normalization for benefit criteria utilizes equation (5), whereas for cost criteria, equation (6) is employed. The computational process to obtain normalization for each attribute can be explained as follows:

\[
X_{01} = \frac{4}{3+4+4+2+4} = 0.2353 \\
X_{11} = \frac{4+3+4+2+4}{3} = 0.1765 \\
X_{21} = \frac{4+3+4+2+4}{4} = 0.2353 \\
X_{31} = \frac{4+3+4+2+4}{2} = 0.1176 \\
X_{41} = \frac{4+3+4+2+4}{4} = 0.2353 \\
X_{02} = \frac{4+4+4+3+2}{2} = 0.2353
\]

In Table 3, the criteria used are listed, including the value ranges and value weights for each criterion. The next step involves identifying the alternatives to be chosen, namely products such as Beholder DS1 (A1), Zhiyun Tech Weebill S (A2), Feiyu Tech Scorp C (A3), and Gudsen Moza AirCross S (A4). Each alternative is then assigned values based on the relevant criteria according to the specifications of each product. Information regarding the value outcomes for each alternative in this case study is documented in Table 4.

### Table 4. Alternative Values Based on Criteria

<table>
<thead>
<tr>
<th>Code</th>
<th>Alternative Name</th>
<th>Criteria</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Beholder DS1</td>
<td></td>
<td>3 Device</td>
<td>14 hours</td>
<td>2,500 grams</td>
<td>4,950,000</td>
<td>3 Axis</td>
</tr>
<tr>
<td>A2</td>
<td>Zhiyun Tech Weebill S</td>
<td></td>
<td>4 Device</td>
<td>14 hours</td>
<td>3,000 grams</td>
<td>6,311,000</td>
<td>3 Axis</td>
</tr>
<tr>
<td>A3</td>
<td>Feiyu Tech Scorp C</td>
<td></td>
<td>2 Device</td>
<td>13 hours</td>
<td>2,500 grams</td>
<td>3,499,000</td>
<td>3 Axis</td>
</tr>
<tr>
<td>A4</td>
<td>Gudsen Moza AirCross S</td>
<td></td>
<td>4 Device</td>
<td>10 hours</td>
<td>1,800 grams</td>
<td>3,533,000</td>
<td>3 Axis</td>
</tr>
</tbody>
</table>

The results of giving alternative values to the criteria, in accordance with product specifications, are documented in Table 4. Moreover, these values undergo conversion to facilitate calculations in identifying the optimal alternative, as indicated in Table 3. The outcomes of the value conversion process conducted are delineated in Table 5.

### Table 5. Results of Value Conversion

<table>
<thead>
<tr>
<th>Code</th>
<th>Alternative Name</th>
<th>Criteria</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Beholder DS1</td>
<td></td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>A2</td>
<td>Zhiyun Tech Weebill S</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>A3</td>
<td>Feiyu Tech Scorp C</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>A4</td>
<td>Gudsen Moza AirCross S</td>
<td></td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

In Table 5, the values of each alternative are documented after undergoing the conversion process, which then becomes the initial decision matrix values. In addition to the values for each attribute, the initial decision matrix also includes the optimal values (x0). These optimal values are determined according to the type of criterion; if the criterion is a benefit, equation (2) is used, and if the criterion is a cost, equation (3) is used. In this context, there are 3 benefit criteria, namely C1, C2, and C4, and 1 cost criterion, namely C3. Therefore, the optimal values (x0) are generated as follows: {4; 4; 4; 2; 4}. All attribute values and optimal values are then integrated into the matrix following the guidelines of equation (4). Below are the results of the initial decision matrix:

\[
X = \begin{bmatrix}
4 & 4 & 4 & 2 & 4 \\
3 & 4 & 4 & 3 & 4 \\
2 & 3 & 4 & 2 & 4 \\
4 & 2 & 2 & 2 & 4
\end{bmatrix}
\]


The following is the process for obtaining the weighted normalized attribute value:

\[ X_{ij} = \begin{pmatrix} 0.2353 & 0.2353 & 0.2222 & 0.2400 & 0.2000 \\ 0.1765 & 0.2353 & 0.2222 & 0.1600 & 0.2000 \\ 0.2353 & 0.2353 & 0.2222 & 0.1200 & 0.2000 \\ 0.1176 & 0.1765 & 0.2222 & 0.2400 & 0.2000 \\ 0.2353 & 0.1176 & 0.1111 & 0.2400 & 0.2000 \end{pmatrix} \]

The next step is to obtain the values of attributes that have been normalized and weighted, and then organize them into a weighted normalized decision matrix. To obtain the weighted normalized values, equation (7) is utilized, where the weight values refer to the results of weight calculations using the Rank Reciprocal approach outlined in Table 2. The following is the process for obtaining the weighted normalized attribute value:

\[
X_{i} = \begin{pmatrix} 0.2353 & 0.2353 & 0.2222 & 0.2400 & 0.2000 \\ 0.1765 & 0.2353 & 0.2222 & 0.1600 & 0.2000 \\ 0.2353 & 0.2353 & 0.2222 & 0.1200 & 0.2000 \\ 0.1176 & 0.1765 & 0.2222 & 0.2400 & 0.2000 \\ 0.2353 & 0.1176 & 0.1111 & 0.2400 & 0.2000 \end{pmatrix}
\]

Based on the normalization results, each attribute is then arranged into a matrix as follows:

\[
D_{01} = 0.2353 \times 0.4380 = 0.1035 \\
D_{11} = 0.1765 \times 0.4380 = 0.0776 \\
D_{21} = 0.2353 \times 0.4380 = 0.1035 \\
D_{31} = 0.1176 \times 0.4380 = 0.0518 \\
D_{41} = 0.2353 \times 0.4380 = 0.1035 \\
D_{02} = 0.2353 \times 0.2190 = 0.0518 \\
D_{12} = 0.2353 \times 0.2190 = 0.0518 \\
D_{22} = 0.2353 \times 0.2190 = 0.0518 \\
D_{32} = 0.1765 \times 0.2190 = 0.0388 \\
D_{42} = 0.1176 \times 0.2190 = 0.0259 \\
D_{03} = 0.2222 \times 0.1460 = 0.0311 \\
D_{13} = 0.2222 \times 0.1460 = 0.0311 \\
D_{23} = 0.2222 \times 0.1460 = 0.0311 \\
D_{33} = 0.2222 \times 0.1460 = 0.0311 \\
D_{43} = 0.1111 \times 0.1460 = 0.0156 \\
D_{04} = 0.2400 \times 0.1095 = 0.0264 \\
D_{14} = 0.1600 \times 0.1095 = 0.0176 \\
D_{24} = 0.1200 \times 0.1095 = 0.0132 \\
D_{34} = 0.2400 \times 0.1095 = 0.0264 \\
D_{44} = 0.2400 \times 0.1095 = 0.0264 \\
D_{05} = 0.2000 \times 0.0876 = 0.0180 \\
D_{15} = 0.2000 \times 0.0876 = 0.0180 
\]
After multiplying the normalized value for each attribute by its weight, the next step is to arrange the results into a weighted normalized matrix, as follows:

\[ D_{ij} = \begin{bmatrix}
0.1035 & 0.0518 & 0.0311 & 0.0264 & 0.0180 \\
0.0776 & 0.0518 & 0.0311 & 0.0176 & 0.0180 \\
0.0518 & 0.0388 & 0.0311 & 0.0264 & 0.0180 \\
0.1035 & 0.0259 & 0.0156 & 0.0264 & 0.0180 \\
\end{bmatrix} \]

After that, the next step is to calculate the optimal value \( S_i \) for each alternative using equation (8). Details of the calculation steps can be found in the following discussion:

\[ S_0 = 0.1035 + 0.0518 + 0.0311 + 0.0264 + 0.0180 = 0.2308 \]
\[ S_1 = 0.0776 + 0.0518 + 0.0311 + 0.0176 + 0.0180 = 0.1961 \]
\[ S_2 = 0.1035 + 0.0518 + 0.0311 + 0.0132 + 0.0180 = 0.2176 \]
\[ S_3 = 0.0518 + 0.0388 + 0.0311 + 0.0264 + 0.0180 = 0.1661 \]
\[ S_4 = 0.1035 + 0.0259 + 0.0156 + 0.0264 + 0.0180 = 0.1894 \]

The next step ends with finding the utility value \( K_i \) as an assessment of the performance of each alternative using equation (9). The calculation process can be explained through the following steps:

\[ K_1 = \frac{0.1961}{0.2308} = 0.8497 \]
\[ K_2 = \frac{0.2176}{0.2308} = 0.9428 \]
\[ K_3 = \frac{0.1661}{0.1894} = 0.7197 \]
\[ K_4 = \frac{0.2308}{0.2308} = 0.8205 \]

Based on the utility value \( K_i \), the highest value obtained becomes the best recommendation. After getting all the utility values \( K_i \) ranking is then carried out, as shown in Table 6.

**Table 6. Ranking of Utility Values for Each Alternative**

<table>
<thead>
<tr>
<th>Alternative ID</th>
<th>Alternative Name</th>
<th>( K_i ) value</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>Zhiyun Tech Weebill S</td>
<td>0.9428</td>
<td>1</td>
</tr>
<tr>
<td>A1</td>
<td>Beholder DS1</td>
<td>0.8497</td>
<td>2</td>
</tr>
<tr>
<td>A4</td>
<td>Gudsen Moza AirCross S</td>
<td>0.8205</td>
<td>3</td>
</tr>
<tr>
<td>A3</td>
<td>Feiyu Tech Scorp C</td>
<td>0.7197</td>
<td>4</td>
</tr>
</tbody>
</table>

From Table 6, it can be observed that the utility values from highest to lowest are as follows: Zhiyun Tech Weebill S (A2) with a score of 0.9428, Beholder DS1 (A1) with a score of 0.8497, Gudsen Moza AirCross S (A4) with a score of 0.8205, and Feiyu Tech Scorp C (A3) with a score of 0.7197. Therefore, based on this case study, the Zhiyun Tech Weebill S (A2) alternative is considered the best option.

The results of the analysis and modeling that have been conducted are implemented in the form of a decision support system through coding steps. In this study, the decision support system was developed based on a website using the RapidPHP Editor code editor and MySQL database. This system is equipped with a login form as a mechanism for accessing the system. Upon successful login, users will be directed to the main menu interface. The main menu displays a dashboard containing the main menus of the system as well as charts showing the results of the ARAS method calculations. The interface form of the main menu in this decision support system can be seen in Figure 2.
Figure 2 depicts the main menu interface of the system, where users can select available features and view the recommendations provided by the system through charts displaying the calculation results. This system's main features on the dashboard include managing criteria data, alternatives, alternative values, and ARAS method calculations. To commence the selection of a camera stabilizer, users can input criteria data, alternative data, and alternative value data. Upon inputting the data, the ARAS Calculation menu showcases the optimal alternative results. This functionality elucidates the steps or process involved in implementing the ARAS approach. Additionally, it provides a ranking of alternatives based on their utility values, arranged from highest to lowest. The interface for alternative recommendation results is visualized in Figure 3.

![Figure 2](image-url)

**Figure 2.** Output from the Decision Support System in the form of Alternative Ranking

The output of Figure 3 displays the ranking from the highest to the lowest utility values using the ARAS approach. Zhiyun Tech Weebill S (A2) achieves the highest value with a score of 0.9428. The output of this case study's ARAS method calculation does not show any difference compared to manual calculation results, indicating that the system-generated output is valid. The analysis of the results from the case study indicates that the ARAS method is effective in evaluating and ranking alternatives based on their utility functions.

Following the system's development, the testing phase transitioned to usability testing to ascertain the software's suitability for utilization. End-users should be able to use the software effectively, efficiently, and satisfactorily through usability testing. Sub-criteria used in usability testing include understandability, learnability, operability, and attractiveness. This test involved users who would make investment application selections and used a questionnaire with a Guttman scale consisting of only two answer choices: agree and disagree. Twenty respondents completed the questionnaire consisting of ten questions. We then processed the results by calculating the percentage of agree and disagree responses and visualized them in graph form in Figure 4.

![Figure 4](image-url)

**Figure 4.** Results of User Responses to the Usability of the Developed System

The results of the usability testing in Figure 4 indicate that respondents provided agreement for the sub-criteria as follows: 85% for understandability, 85% for learnability, 95% for operability, and 90% for attractiveness. If these values are averaged, the usability testing score is calculated to be 88.75%. Furthermore, the results of the usability testing obtained are classified based on the range of values as follows: “Good” with values between 76% to 100%; “Fair” with values between 56% to 75%; “Poor” with values between 40% to 55%, and...
"Not Good" if less than 40% [26]. With a usability testing score of 88.75%, it can be concluded that the decision support system for camera stabilizer selection falls within the "Good" category. This indicates that users perceive the system as effective, efficient, and satisfactory.

4. CONCLUSION

This study implemented the development of a decision support system for selecting a camera stabilizer by applying a combination of Rank Reciprocal and Additive Ratio Assessment (ARAS) approaches. The Rank Reciprocal approach assigns weights to each criterion based on its ranking, where these weights are the inverse values of the rankings. Meanwhile, the best alternative is determined using the ARAS method by calculating utility scores for each alternative, which involves computing the ratio of the sum of the product of criterion weights and the performance values of each alternative to the ideal or optimal values that can be achieved. Based on the conducted case study, the results revealed the highest to lowest utility values as follows: Zhiyun Tech Weebill S (A2) obtained a score of 0.9428, Beholder DS1 (A1) obtained a score of 0.8497, Gudsen Moza AirCross S (A4) obtained a score of 0.7197, and Feiyu Tech Scorp C (A3) obtained a score of 0.8205. The results obtained by the decision support system (DSS) in this case study are consistent with manual calculations, indicating that the application of ARAS in the system can be considered valid. The usability testing achieved an average score of 88.75%, suggesting that the system can be deemed suitable for use as it meets the desired functionalities by users. However, for future research, several improvement recommendations can be considered. In determining weights using Rank Reciprocal, which is susceptible to subjectivity in ranking determination, it is suggested to integrate fuzzy logic algorithms to obtain more objective evaluations. Furthermore, considering the data used encompasses both quantitative and qualitative types, enhancements are needed to ensure more accurate conversion values when evaluating alternatives against existing criteria.

REFERENCES


