Decision Support System to Choose Digital Single Lens Camera with Simple Additive Weighting Method

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Abstract

One of the technologies that evolve today is Digital Single Lens Reflex (DSLR) camera. The number of products makes users have difficulties to choose the appropriate camera based on their criteria. Users may utilize several ways to help them choosing the intended camera such as using magazine, internet, and other media. This paper discusses about a web based decision support system to choose cameras by using SAW (Simple Additive Weighting) method in order to make the decision process more effective and efficient. This system is expected to give recommendations about the camera which is appropriate with the user's need and criteria based on the cost, the resolution, the feature, the ISO, and the censor. The system was implemented by using PHP and MySQL. Based on the result of questionnaire distributed to 20 respondents, 60% respondents agree that this decision support system can help users to choose the appropriate camera DSLR in accordance with the user's need, 60% of respondents agree that this decision support system is more effective to choose DSLR camera and 75% of respondents agree that this system is more efficient. In addition, 60.55% of respondents agree that this system has met 5 Es Usability Framework.

Keywords: *Simple additive weighting (SAW), decision support system (DSS), DSLR camera.*

1. INTRODUCTION

In this digital era, technologies have been part of any aspects of human life. Technologies help people to solve many problems. One of the technologies that evolve today is Digital Single Lens Reflex (DSLR) camera. A DSLR camera is a digital camera that uses processor, chip, memory, and other advanced technologies to capture image by using one single lens embedded in camera body [1]. Many number of high qualified camera products equipped with advanced technologies can be found in the market to fulfill costumers needs [2].

Usually, costumers utilize several ways to help them choosing the intended camera such as using magazine, internet, flyers, and word of mouth. After getting enough information, costumers usually compare the information with available budget as well as their particular needs. This way is effective but is not efficient due to the time and cost needed to gather information. Furthermore, various number of products makes costumers have difficulties to choose the appropriate camera based on their own criteria**.**

Based on the above mentioned problem, the authors developed a decision support system to help costumers choosing suitable camera based on their own criteria. The system was developed using Simple Additive Weighting method.

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2. METHOD

2.1. Fundamental Theory
2.1.1   Decision Support System

A decission support system can be defined as a system that has ability to provide solution for semi-stuctured problem [3]. A decision support system as a system may support the performance of a manager or a group of managers in solving semi-structured problem by providing information or recommendation towards a particular solution.

A decision support system can solve several type of problems as follows [3]:

1. Structured decision

   Structured decision is a routine decision which is performed repeatedly. The procedure to make decision is clear. This type of decision usually can be found in low level management.

2. Semistructured decision

   Semistuctured decision is a decision that has two characteristics. One part of the system will be handled by computers, while the other part should be handled by the decision maker. The procedure to make decision exists in general. However, several steps of the procedure need decision maker policy. Usually this type of decision is taken by middle level managers.

3. Unstructured decision

   Unstructured decision is a complex decision which is not repeated or not always happened. This type of decision require experiences and various external resources. It is usually found in the high level management.

The application of a decision support system consists of several subsystems [4], namely :

1. Data management subsystem

   Data management subsystem contains a database which is relevant to the problem. The database will be managed with a Data Base Management System.

2. Model management subsystem

   Model management subsystem contains quantitative model such as financial, statistics, scientific management, or other quantitative models to give analytical capability to the decision support system.

3. Dialog management subsystem

   Dialog management subsystem contains facilities for users to communicate with the system via user interfaces.

4. Knowledge management subsystem

   Knowledge management subsystem contains support to the three other subsystems. This subsystem is optional. Usually the subsystem can be found in the decision of a complex problem. A decision support system which contain knowledge management subsystem known as knowledge-based decision support system.

2.1.2 Simple Additive Weighting

Simple Additive Weighting (SAW) method is the simplest and still the widest used Multi Atribute Decision Making (MADM) method [5]. In this method, each attribute is given a weight and the sum of all weights must be 1.The basic concept of SAW is finding weighted sum of performance rating of each alternative over all attributes. SAW method will construct a decision matrix, normalize the matrix, and then multiply the matrix with the weight of each attribute.

The step wise procedure of SAW is given below [6][7]:
1. Let C = (c_1, c_2, c_3, ..., c_n) be a set of criteria and A = (a_1, a_2, a_3, ..., a_m) be a set of alternatives.
2. Construct a weighted vector W_j for every alternatives in which $\sum_{j=1}^{m} w_j = 1$
3. Construct a decision matrix D, where d_{ij} is the rating of alternative A_i with respect to criterion C_j.

4. Construct the normalized decision matrix with the following rule:

   - For beneficial attribute (criteria of benefit):
   $$r_{ij} = \frac{d_{ij}}{\max d_{ij}} \tag{1}$$
   - For non beneficial attribute (criteria of cost):
   $$r_{ij} = \frac{\min x_{ij}}{x_{ij}} \tag{2}$$

5. Construct weighted normalized decision matrix :
   $$V_{ij} = w_i r_{ij} \tag{3}$$

6. Calculate the score of each alternative:
   $$S_i = \sum_{j=1}^{m} V_{ij} \tag{4}$$

7. Rank the alternatives in descending order. The highest score is the best alternative solution.

2.1.3. 5 Es Usability Framework

5 Es Usability Framework is a framework that can be used to help in evaluating usability of a software system. It consists of 5 aspects namely:
1. Effective: how a software can be utilized to achieve the objectives of users. The software system is effective when it is able to help users achieving their objectives. Therefore, the system should be relevant which mean able to fullfill users needs, able to answer users questions, and ablt to help users accomplished their tasks.

2. Efficient: how fast the task will be accomplished by using the system. Navigation elements such as menu, link, and other buttons give impacts to the efficiency.

3. Engaging: how good the user interface is for its users to help them interact with the system. The design on visual elements play important roles in this aspects.

4. Error tolerant: how good the system will be able to prevent error an how helpfull the application able to help users recover from errors when it happened.

5. Easy to learn: how good the system support users to learn using the system and exploring the features of the system.

2.2. Methods

The system was developed with the following steps:
1. Planning phase: determine the goal and objective of the decision support system.
2. Data gathering through the following activities:
   a. Interview and distribute questionnaire to a student photography community to determine the criteria that will be used in the system.
   b. Collect camera specification through the site www. Canon.co.id and Cameradecision.com.
   c. Literature study to explore the model of decision making.
3. Develop the system by applying Framework of Application System Thinking (FAST) methodology [8] to design and implement 3 components of decision support system namely data management subsystem, model management subsystem, and dialog management subsystem. Knowledge management subsystem was not applied in this system.
4. Perform system testing by applying black box testing and users testing. Black box testing was performed by trying all use cases and scenarios to find out whether all features functioned nornally. In the users testing, 20 users were asked to use the system an evaluate the system by using a questionnaire which is composed using 5 Es Usability Framework.
5. Analyze the validity, effecivity, and efficiency of the system based on the result of the testing.
6. Conlude the analysis.

3.   RESULTS AND DISCUSSIONS

3.1. System Design
The system was designed for two categories of users namely administrator and users. There are two clusters of functions provided for administrator as follows:

1. Managing cameras: add, edit, delete, and browse cameras and the corresponding specifications.
2. Managing criterias: add, edit, delete, and browse criteria to be used by users.

Meanwhile, users have the following functions:

1. Browsing all cameras stored in the databases
2. Choosing particular cameras to be compared by determining certain interval of prices
3. Asking for recommendations from the system.

The process of determining recommendations by the system is described in figure 1.
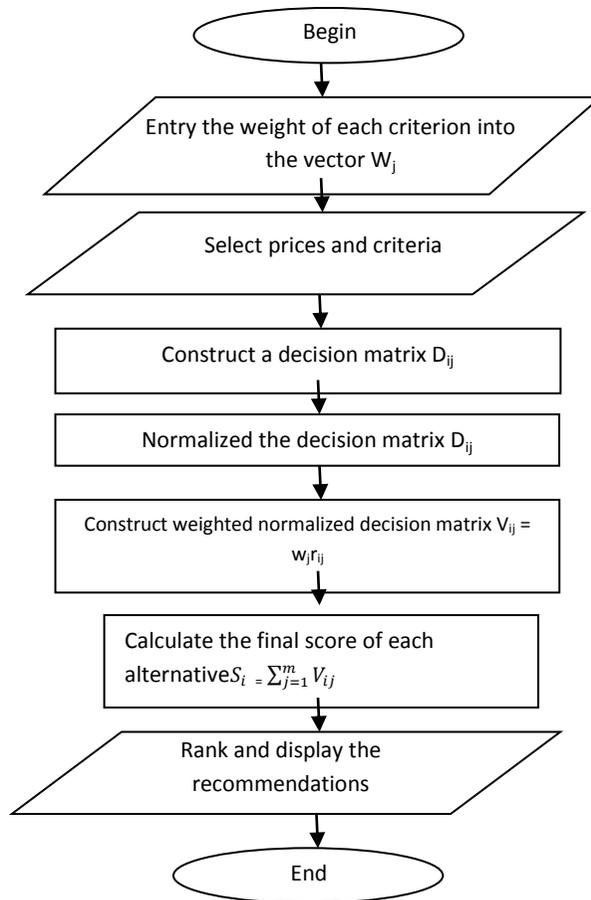
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                    ┌──────────────┐
                    (    Begin     )
                    └──────────────┘
                           │
                           ▼
          ╱──────────────────────────────────╱
         ╱  Entry the weight of each criterion into  ╱
        ╱           the vector W_j            ╱
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         ╱      Select prices and criteria    ╱
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          ┌──────────────────────────────────┐
          │  Construct a decision matrix D_ij │
          └──────────────────────────────────┘
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          ┌──────────────────────────────────┐
          │ Normalized the decision matrix D_ij│
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          │ Construct weighted normalized decision matrix V_ij = │
          │              w_j r_ij             │
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          ┌──────────────────────────────────┐
          │   Calculate the final score of each │
          │   alternative                     │
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          ╱──────────────────────────────────╱
         ╱      Rank and display the          ╱
        ╱         recommendations            ╱
       ╱──────────────────────────────────╱
                           │
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                    ┌──────────────┐
                    (     End      )
                    └──────────────┘
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Flowchart elements:
- Begin
- Entry the weight of each criterion into the vector W_j
- Select prices and criteria
- Construct a decision matrix D_{ij}
- Normalized the decision matrix D_{ij}
- Construct weighted normalized decision matrix $V_{ij} = w_j r_{ij}$
- Calculate the final score of each alternative $S_i = \sum_{j=1}^{m} V_{ij}$
- Rank and display the recommendations
- End

Figure 1. Flowchart of the system

3.2. System Implementation

The system was implemented as a web based decision support system by using PHP and MySQL. Figure 2 describes the home page of the system. Figure 3 is the page to entry the weight of each criteria, while figure 4 is the page to select prices of cameras as well as criteria. Figure 5 is the page to display the recommendation of the system.
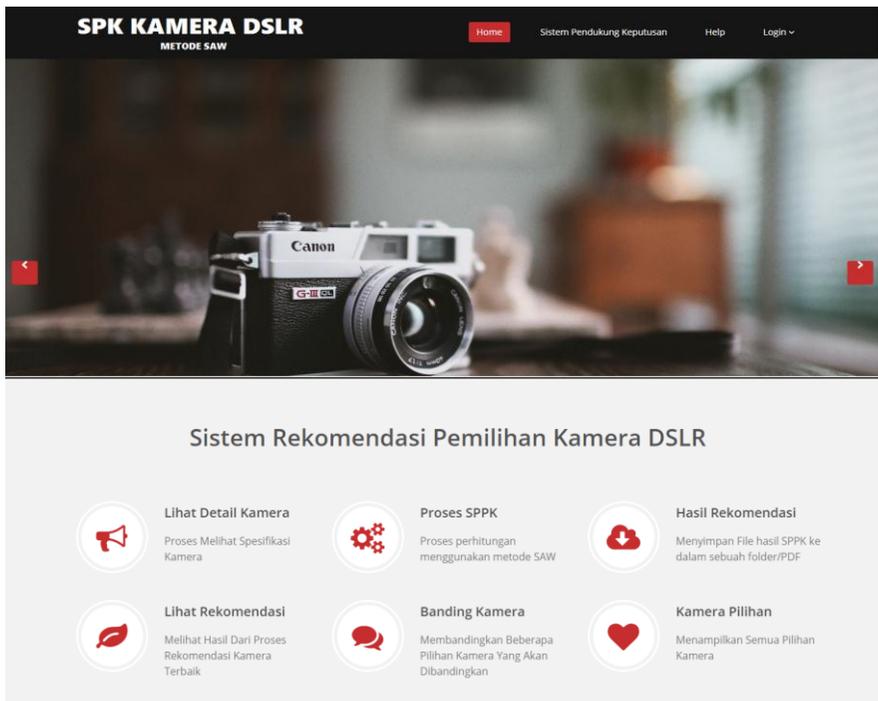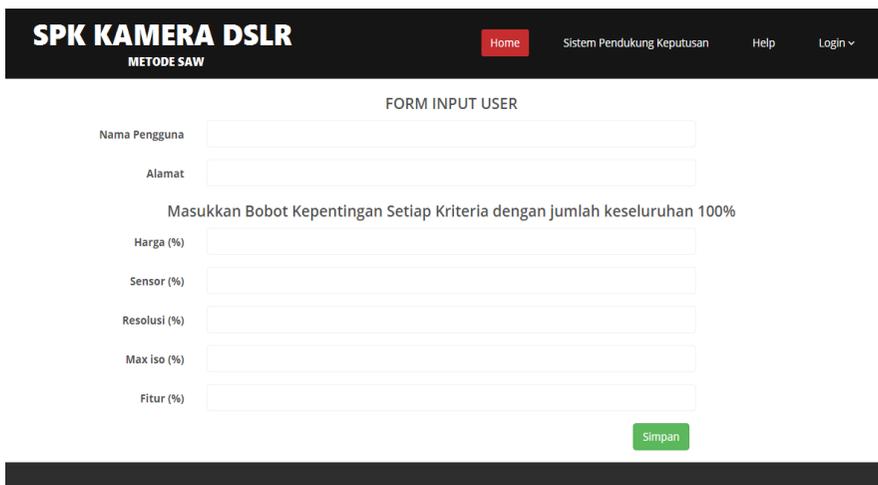
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Figure 2. Home Page of the System

Figure 3. Page to Entry the Weight

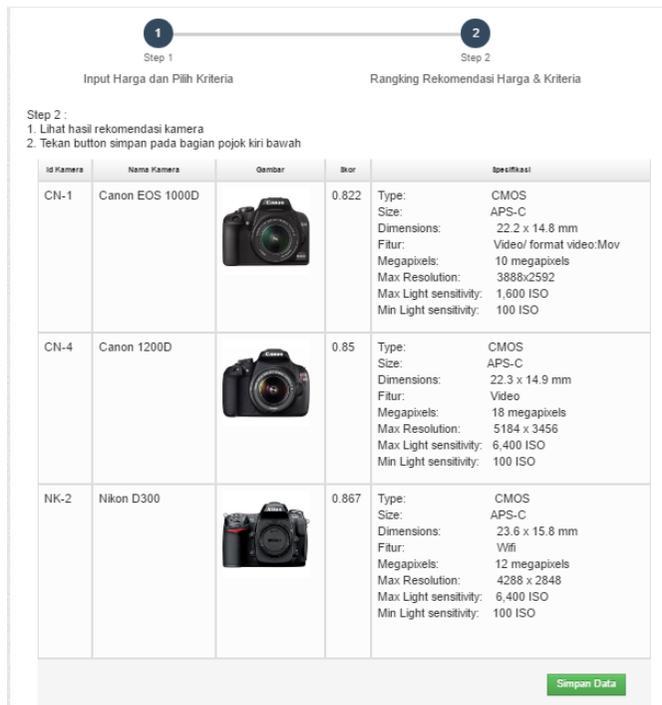**Figure 4.** Page to Select Price and Criteria

Figure 5. Recommendation of the System

3.3. System Testing

3.3.1 Black Box Testing

A black box testing was performed by try each use case of the system to check wether it performs as expected or not. Based on the black box testing, it can be concluded that the system is able to produce output as expected by users and able to handle errors when the functions do not perform normally.

3.3.2   Users Testing

The system was also tested towards 20 respondents who were asked to try the system and then to fill up a questionnaire. The result of the questionnaire is described in table 1 as follows.

Table 1. The Result of Users Questionnaire

Question	VA	A	D	NA	VNA
1. The system can support decision making to choose DSLR camera.	40 %	60%			
2. Using this system, the process of choosing DSLR camera is more effective.	40%	60%			
3. Using this system, the process of choosing DSLR camera is more efficient.	25%	75%			
4. The features of the system can be used effectively by users.	30%	55%	15%		
5. The features of the system can be used efficiently by users.	25%	60%	15%		
6. The features of the system can be used understood by users.	20%	55%	15%	10%	
7. The features of the system help users to choose criteria based on users' intentions.	10%	75%	15%		
8. The features of the system ease users to manage relative weight of importance of each criterion.	20%	65%	15%		
9. The features of the system ease users to choose DSLR camera based on the price and users criteria.	30%	65%	5%		
10. The features of the system ease users to compare particular DSLR cameras as users want.	30%	65%	5%		
11. The feature to print the result of recommendation ease users to look carefully the recommendations of the system.	35%	55%	10%		
12. The steps to display recommedation are understandable.	10%	50%	40%		
13. The user interface of the system is interesting and ease users to use the system.	40%	55%	5%		
14. The guideline and help features provided in the system can ease users to use the system.	20%	70%	10%		
15. The language used in the system is understandable for users.	20%	70%	10%		
16. Users satisfy with the recommedations of the system.	35%	55%	10%		

*) VA = Very Agree, A = Agree, D = Doubt, NA = Not Agree, VNA = Very Not Agree

4. CONCLUSION

Based on the system and user testing, it can be concluded that the web-based decision support system to choose DSLR camera by using Simple Additive Weghting method has been successfully developed. The system has met users' requirements and criterion. 60% of respondents agree that this decision support system is more effective to help users choose DSLR camera and 75% of respondents agree that this system is more efficient. In addition, 60.55% of respondents agree that this system has met 5 Es Usability Framework. Future work to improve usability of the system is recommended.

5. REFERENCES

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