Implementation of Decision Support System for choosing Pre-wedding Photo Service

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Abstract

Decision making is the selection of a course of action from a number of possible alternatives on the various forms of evidences. Multi-criteria decision making (MCDM) is a discipline to support the decision makers who faced with making numerous and conflicting evaluations. Analytic Hierarchy Process (AHP) is one of the problem solving techniques of MCDM and a popular multiple-criteria decision making tool based on hierarchical structure. AHP can be used with both quantitative and qualitative data. In this system, AHP is applied to develop the best selection among various pre-wedding photo service packages that also satisfied with the user desire. Therefore, the user can easily decide and choice the pre-wedding photo service packages by using this system.

Keywords*: Multi-Criteria Decision Making (MCDM); Analytic Hierarchy Process (AHP)*

1. Introduction

Nowadays, most couples are very interesting in pre-wedding photography shooting before their wedding time. Pre-wedding shoots may be a relatively new trend but they come with various benefits such as it can ensure that to describe the modern living standard. Some couples choose to have their pre-wedding photographs taken at their wedding venue, whilst others decide to option an entirely different location. Some people choose to enlist the services of others who will be working with them on their wedding day. Mostly, every couple prefers to have the printed vinyl and put it on their wedding ceremony, whilst others may upload them onto their social media accounts to show to their friends and family. Some couple may even decide to keep them as private visual documents.

The major benefit of taking the pre-wedding services is that it enables couples to focus on enjoying their loyal day once it arrives. If the couple takes the pre wedding service, the couple doesn't need to drag away from friends and family in time and time again for shooting photographs to be taken in their ceremony. That's why, every couple crazy to shoot pre-wedding photography. There are many pre wedding studio (services) in Myanmar. They offer a lot of packages with various prices and attractive services by competition of each other studio, respectively. This system is intended to guide the couple who are wishing to shot memorable photos for their wedding.

Decision support system is a type of information system whose principal objective is to support a human decision maker during the process of arriving at a decision. Multi-criteria decision making (MCDM), sometimes called multi-criteria decision analysis (MCDA), is a discipline aimed at supporting decision makers who are faced with making numerous and conflicting evaluations[4]. MCDA aims at highlighting these conflicts and deriving a way to come to a compromise in a transparent process. AHP is one of the problem solving techniques of MCDM. AHP is a popular multiple-criteria decision making tool based on hierarchical structure. The AHP can be used with both quantitative and qualitative data. One reason for it's the popularity of AHP among researchers and practitioners are the relative simplicity in conception and application compared to other methods for multi-criteria analysis[8].

We would like to present the paper with six different sections. In section 1, we introduce about why we intended to implement the decision support system for choosing pre-wedding photo services. The remaining sections of this paper are organized as follows. In section 2, the related work will be described. In section 3, the background theories which are the decision support system, multi criteria decision making, analytical hierarchy process and consistency ratio will be discussed. In section 4, the next section will illuminate about the design and experimental result of the system. Finally, the conclusion of the system will be described.

2. Related Works

There are many application areas which applied the AHP method. The following solicitations illustrate the wide breath of areas to which AHP has been applied. AHP is an approach to decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives. Thomas L. Saaty introduce that AHP is especially suitable for complex decisions which involve the comparison of decision elements which are difficult to quantify. It is based on the assumption that when faced with a complex decision the natural human reaction is to cluster the decision elements according to their common characteristics.

M. Bevilacqua, M. Braglia proposed about AHP in selecting the optimal maintenance alternative for an integrated gasification combined cycle plant. With the complexity of the process considered, the case study is left with six of the most important criteria: safety, equipment, failure frequency, downtime length, and operating conditions. In this case, machines are divided into three main categories based on the consequences of failure. The outcome of the study showed that predictive maintenance facilitates Group 1. Group 2 reveals a slight preference for opportunistic maintenance, whereas preventive maintenance and corrective maintenance suit Group 3. L. Wang, J. Chu, J. Wu used AHP in maintenance alternative selection for a thermal power plant by using four criteria: safety, added value, cost, and feasibility. The result showed that PM is the most suitable alternative.

H. Fazlollahtabar and N. Yousefpoor adopted the AHP to identify the optimal maintenance alternative for a machine used in virtual learning aimed at increasing reliability and availability levels. In addition, M. Ilangkumaran, S. Kumanan also presented how the AHP method is used to decompose an optimal maintenance alternative selection problem in the textile industry. The problem was structured into four levels, with four criteria in the second level, and further decomposed into eight sub-criteria in the third level. AHP is used to scale the weight for each criterion. The outcome of the AHP method is further continued using TOPSIS to rank the alternatives. S. Gassner also used AHP to determine a suitable maintenance alternative for a wind turbine machine by taking implications of cooperative alliances into consideration during decision making process. Under similar circumstances, R.M.C. Ratnayake and T. Markeset suggested the use of AHP to measure health, safety, environment awareness, and cost issues during maintenance alternative decision making in the oil and gas industries. Z. Tan and J. Zheng adopted AHP to select the most practical maintenance alternative for machines with different operational functions in the oil refinery industry.

Kamal M. Al-Subhi Al-Harbi described about application of the AHP in project management paper. The AHP is a decision-aiding method developed by Saaty. The Xerox Corporation uses AHP for decisions on portfolio management, technology implementation, and engineering design selection. AHP is also used to help make marketing decisions regarding market segment prioritization, product market matching, and customer requirement structuring. The AHP implementation steps will be simplified by using the Expert Choice professional software that is available commercially and designed for implementing AHP.

3. Background Theory

Decision support system is a type of information system whose principal objective is to support a human decision maker during the process of arriving at a decision. Decision making is the selection of a course of action from a number of possible alternatives on various forms of evidence. And, another mean is the mental or intellectual process of forming an opinion or evaluation by discerning and comparing.

3.1. Multi-criteria Decision Making (MCDM)

Multi-criteria decision making (MCDM) is a set of systematic procedures for analyzing complex decision problem. These procedures include dividing the decision problems into smaller more understandable part: analyzing each part; and integrating the part in a logical manner to produce a meaningful solution[1]. MCDA aims at highlighting these conflicts and deriving a way to come to comprise in a transparent process. The measurement in MCDA is derived or interpreted subjectively as indicators of the strength of various preferences. Preferences differ from decision maker to decision maker, so the outcome depends on who is making the decision and what their goals and preferences [10]. MCDA is selection of the best action from a set of

alternatives, each of which is evaluated against multiple, and often conflicting criteria. The analytic hierarchy process is one of the MCDM methods.

3.2. Analytical Hierarchy Process (AHP)

The analytic hierarchy process (AHP) is a structured technique for dealing with complex decisions. AHP is a powerful and flexible decision making process. The AHP helps the decision makers to find the one which is the best suits for their requirement. AHP is an approach that is suitable for dealing system related to make a choice from among multiple alternatives and which provides a comparison of the considered options.

The AHP is based on the subdivision of the problem in a hierarchical form. Then, AHP synthesizes the results by reducing complex decisions to a series of simple comparisons and rankings. The AHP not only helps the analysts to arrive at the best decision, but also provides a clear rationale for the choices. One of the main advantages of AHP is the relative ease with which it handles multiple criteria. The core of AHP is the preference matrix consisting of pair-wise comparison. The comparison are made using a scale of judgments that represents, how much more one of the element dominates to another.

AHP Method

AHP method approaches as the following five steps:

1. Pair-wise comparison of criteria
2. Establish priority vector for criteria
   i. Sum the values in each column of the pair-wise comparison matrix.
   ii. Divide each element in the pair-wise comparison matrix by its column total.
   iii. Compute the average of the elements in each row of the normalized pair-wise comparison matrix; these averages provide the priorities for the criteria.
3. Pair-wise comparison of alternatives
4. Establish priority vector for alternatives
5. Obtaining the overall ranking

This system uses the numerical values for preferences, in each of the comparison step. These preferences describe in Table 1.

Table 1. Fundamental Scales for Pair Wise Comparison

Numerical Scale	Definition of Important
1	Equally important
3	Moderately important
5	Strongly important
7	Very Strongly important
9	Extremely important
2, 4, 6 and 8	Intermediate values

In pair-wise comparisons, a ratio scale of 1-9 is used to compare any two elements. A reciprocal value is assigned to the inverse comparison; that is, $a_{ij}=1/a_{ji}$, where a_{ij} (a_{ji}) denotes the importance of the i^{th} (j^{th}) element.

AHP Algorithm

Begin
1. Accept weight values n-criteria
2. Create priority matrix for Overall Criteria
   2.1 setMatrix (n)
   2.2 normalizeMatrix (n)
   2.3 calculatePriorityVector (n)
3. Create priority matrix for Each Criteria
   3.1 setMatrix (totalRecord)
   3.2 normalizeMatrix (totalRecord)
   3.3 calculatePriorityVector (totalRecord)
4. Create priority matrix for Overall Ranking
   4.1 overallRank (n, totalRecord)
   4.2 calculatePriorityVector (n, totalRecord)
5.Find the Best Ranking according to Highest Priority
End

```
Procedure setMatrix(n)
for(jnt  j=0;  j<n(n-1)/2;  j++)
begin
    for(jnt  k=0;  k<n(n-1)/2;  k++)
     begin
        if  (j=k)  then  ajk =1
        else if  (j<k)  then  ajk = related value
        else        akj=1/ ajk
     end
end
for(jnt  j=0;  j<record;  j++)
begin
    for(jnt  k=0;  k<record;  k++)
     begin
        if  (j=k)  then  ajk =1
        else if  (j<k)  then  ajk = related value
        else        akj=1/ ajk
     end
end
```

```
Procedure   normaljzeMatrjx(n)
for(jnt   j=0;  j<record;  j++)
begin
    for(jnt   k=0;  k<record;  k++)
     begin
          colsum[j]+=pwcMatrjx[k,j]
     end
end
```

```
Procedure     priorityVector (n)
for(jnt   j=0;  j<record;  j++)
begin
    for(jnt   k=0;  k<record;  k++)
     begin
          priority [j]+=pwcMatrjx[j,k]
     end
     priorityVector [j]= priorityVector [j]/record
end
```

```
Procedure   overallRankjng(n, record)
for(jnt   j=0;  j<n;  j++)
begin
    for(jnt   k=0;  k<record;  k++)
     begin
          overAllRank[k,j]+=priorityVector[k]
     end
          overAllRank[k,j]/n;
 end
```

3.3. Consistency Checking

Consistency can check pair-wise comparison matrix to make sure decision maker comparisons were consistent or not with the four steps. The first step is finding the weighted sum matrix which can be calculated by multiplying each columns and their priority vectors in pair wise comparisons matrices of alternatives for each criteria. The second step is dividing all the element of the weighted sum matrices by their respective priority vector element, then compute the average of these values to obtain ($\lambda_{\max}$).The third step finds the consistency index CI,

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

The last step is selecting the appropriate value of random consistency ratio, RI, for a matrix size using the below Table 2.

Table 2. Random Consistency Ratio

Matrix size	1	2	3	4	5	6	7	8	9
Random consistency	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

The calculation for consistency ratio is

$$CR = \frac{CI}{RI} \qquad (2)$$

If the value of CR is less than 0.1, the judgments are acceptable. Otherwise, the judgments aren't acceptable.

4. System Design and Experimental Result

The main purpose of this system is to give a valuable suggestion for user to choose places which match with the user desired. In this system, data are collected from various trip agencies via online. Each trip has been record as transaction. This system is stored about four hundred transactions in database. Each transaction has seven attributes. They are TID, Place Name, Cost, Place Type, Time Taken, Transportation Type and Popular Rate, respectively.

4.1. System Design

This system supports two types of users such as administrator and user as shown in Figure 1.

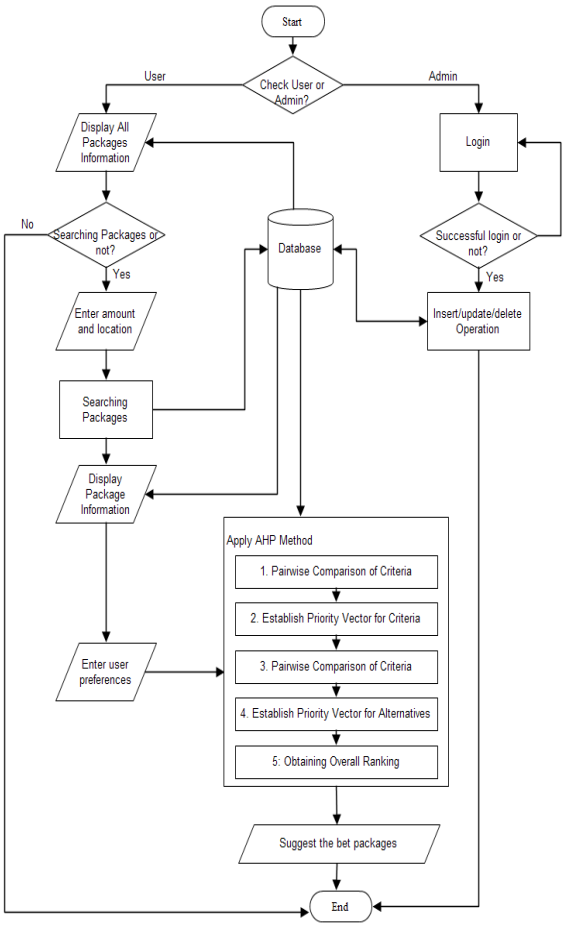

Figure 1. System Design

In this system, the administrator can manage the list of pre-wedding photo services such as inserting, updating and deleting the existing packages

or studio, respectively. Firstly, the user must input their preferences to the system in order to choose the best packages. The satisfied results may be more than one package for taking the pre-wedding photo service. Many pre-wedding photo services lead for confusing the mind, such as, “That package is a nice”, “This package is also I like”, “These facts are also I consider to take the services”, and so on. These confusion leads to the times and energy consuming. In this situation, user needs to take suggestion from consultant. Therefore, this system is implemented to overcome from bewildering choices by applying AHP method. After giving the user’s preferences, this system will report the best packages as the decision result according to their AHP method.

The system makes the pair-wise comparison for each criterion by using the fundamental scales as shown in Table 1. “Will each factor be more important on other factor?" question is used on the eight criteria. All criteria are compared with each other to determine the relative importance of each factor in accomplishing the overall goal. The matrix is then filled with numerical values denoting the importance of the factor on the left relative to the importance of the factor on the top. For example, Price is considered to be three times as important as number of make-up.

4.2. Experimental Result

This system collects the various pre-wedding photo services packages from each agent and then store in database. Therefore, this system firstly requests the user for affordable amount and desired location in order to reduce the processing time. And then, AHP is applied to suggest the best service among the user desired services. This system uses a simple weighing approach to calculated pair wise comparisons and priority vector. And then, the system proceeds to calculate the global values and makes the overall ranking on these global values to suggest the best under the user’s consideration.

In the AHP method, the problem must be structured into a hierarchy which states the overall goal, criteria and alternatives. The goal is to find out the best package. Criteria are situated at the intermediate level. The criteria of the system are price, location, number of dress, dress type, makeup, number of photo, special frame, popular rate, respectively, which contribute to the goal. The base level is the alternatives which are to be evaluated in terms of the criteria in the level above. The system hierarchy for this system is shown in Figure 2.

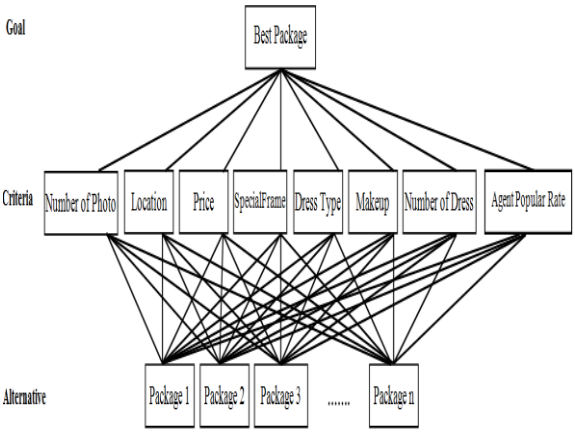

Figure 2. System Hierarchy

Step 1: Pair-wise comparison of criteria

In this step, all criteria are compared with each other to determine the relative importance of each factor in the accomplishing the overall goal.

Table 3. Pair-wise comparison matrix for Overall Criteria

###	Price	Location	NumofDress	DressType	Makeup	NumofPhoto	SpecialFrame	PopularRate
Price	1	5	7	3	9	7	9	1
Location	0.2	1	3	0.333	7	1	5	1
NumofDress	0.143	0.333	1	3	5	7	3	0.2
DressType	0.333	3.003	0.333	1	5	7	3	1
Makeup	0.111	0.143	0.2	0.2	1	5	0.2	0.111
NumofPhoto	0.143	1	0.143	0.143	0.2	1	0.333	0.333
SpecialFrame	0.111	0.2	0.333	0.333	5	3.003	1	0.143
PopularRate	1	1	5	1	9.009	3.003	6.993	1

Step 2: Establish priority vector for criteria

The system will sum values of each column for the pair wise comparison matrix. And then, it will divide each element in the pair wise comparison matrix by its column total. Finally, it will compute the average of the elements in each row of the matrix that provides the priorities for the criteria. This is the priority vector calculation for each criterion.

Table 4. Priority Vector matrix for Overall Criteria

###	Price	Location	NumofDress	DressType	Makeup	NumofPhoto	SpecialFrame	PopularRate
Price	0.329	0.428	0.412	0.333	0.218	0.206	0.316	0.209
Location	0.066	0.086	0.176	0.037	0.17	0.029	0.175	0.209
NumofDress	0.047	0.029	0.059	0.333	0.121	0.206	0.105	0.042
DressType	0.11	0.257	0.02	0.111	0.121	0.206	0.105	0.209
Makeup	0.037	0.012	0.012	0.022	0.024	0.147	0.007	0.023
NumofPhoto	0.047	0.086	0.008	0.016	0.005	0.029	0.012	0.07
SpecialFrame	0.037	0.017	0.02	0.037	0.121	0.088	0.035	0.03
PopularRate	0.329	0.086	0.294	0.111	0.219	0.088	0.245	0.209
Priority Vector	0.306	0.118	0.118	0.142	0.036	0.034	0.048	0.198

Step 3: Pair-wise comparison of alternatives

The system performs comparison process repeatedly for all of each criterion and each one consist of two matrixes. They are pair-wise

comparison matrix and normalized matrix of pair-wise comparison, respectively.

Table 5. Pair-wise comparison matrix for Dress Type

###	Forever	Aroma	Dior
Forever	1	3	9
Aroma	0.333	1	0.111
Dior	0.111	9.009	1

Table 6. Normalized comparison matrix for Dress Type

###	Forever	Aroma	Dior
Forever	0.693	0.231	0.89
Aroma	0.231	0.077	0.011
Dior	0.077	0.693	0.099
Priority Vector	0.605	0.106	0.29

Table 7. Pair-wise comparison matrix for Makeup

###	Forever	Aroma	Dior
Forever	1	7	0.2
Aroma	0.143	1	3
Dior	5	0.333	1

Table 8. Normalized comparison matrix for Makeup

###	Forever	Aroma	Dior
Forever	0.163	0.84	0.048
Aroma	0.023	0.12	0.714
Dior	0.814	0.04	0.238
Priority Vector	0.35	0.286	0.364

Step4: Establish priority vector for all alternatives

Table 9. Priority Vector for all Alternatives

	Price	Location	Number of Dress	Dress Type	Makeup	Number of Photo	Special Frame	Popular Rate
Forever	0.333	0.333	0.134	0.333	0.134	0.333	0.187	0.771
Aroma	0.333	0.333	0.746	0.333	0.120	0.333	0.158	0.105
Dior	0.333	0.333	0.120	0.333	2.237	0.333	0.655	0.124

Step 5: Obtaining the overall ranking

The last step is to obtain the overall ranking of the alternatives by mathematically combining the alternative priority matrix and criteria priority vector from step 1 to step 4. The higher the value, the most suitable of the packages is for user.

The final result from pair wise comparison is as shown in following Table 15. According to the calculation result, this system can give some advices to user for visiting a place which one is R1.

Table 10: Priority and Rank for each place

Overall Priority Package Ranking For Studio Names:	
Forever	0.04345475
Aroma	0.04796425
Dior	0.0335945

Order by:	
Aroma	48%
Forever	43%
Dior	34%

The last step in this system is checking the consistency of pair-wise comparison matrix to make sure decision-makers comparisons were consistent or not. It can be checked by using the Equation (1) and Equation (2), respectively. If the value of CR is less than 0.1, the decision is acceptable.

Consistency Checking for Price Criteria:

λ_{max}= 3, CI= 0, RI= 0.58,CR= 0 <0.1 (Acceptable)

Consistency Checking for Location Criteria:

λ_{max}= 3, CI= 0, RI= 0.58,CR= 0 <0.1 (Acceptable)

Consistency Checking for Makeup Criteria:

λ_{max}= 3.013, CI=0.006, RI= 0.58,CR= 0.011<0.1 (Acceptable)

Consistency Checking for Number of Dress Criteria:

λ_{max}= 3.016, CI= 0.008, RI= 0.58,CR= 0.014<0.1 (Acceptable)

Consistency Checking for Dress Type Criteria:

λ_{max}= 3, CI= 0, RI= 0.58,CR= 0 <0.1 (Acceptable)

Consistency Checking for Number of Photo Criteria:

λ_{max}= 3, CI= 0, RI= 0.58,CR= 0 <0.1 (Acceptable)

Consistency Checking for Special Frame Criteria:

λ_{max}= 3.029, CI=0.015, RI= 0.58,CR= 0.025<0.1 (Acceptable)

Consistency Checking for Agent's Popular Rate Criteria:

λ_{max}= 2.749, CI= -0.126,RI=0.58,CR=-0.216<0.1(Acceptable)

According to the above calculating results, all of the consistency ratios for each criterion are acceptable. The results of consistency ratios for each criterion are described with the line graph as shown in Figure 3. Moreover, the time complexities of the system with containing consistency checking and without consistency checking are also compared as shown in Figure 4.

Figure 3. Consistency Ratio for each criterion

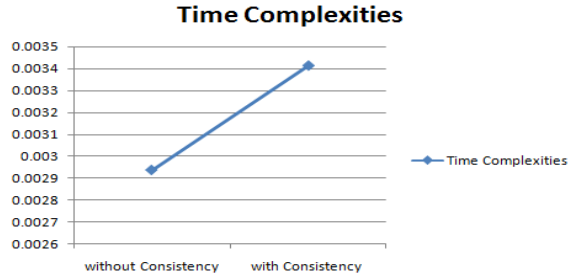

Figure 4. Time Complexities of the System

5. Conclusion

The AHP method is widely used for assist the user in order to get a qualitative decision based on his/her preferences. The AHP method is easy to understand and simplest for solving the complex decision. The system presents the decision making system for choosing pre-wedding photo packages using AHP. The system has intended to implement the decision support system by using AHP and provides the most suitable packages within a short time. By using this system, user can find various pre wedding packages and can choose the preference packages easily. Moreover, it can save the time and cost to choose the best packages because of giving suggestion with the list of priority.

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