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Recommendation System for Smart Mobile Phone selection through e-commerce website using TOPSIS algorithm

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Abstract*—Now days purchasing of any smart mobile phones, specifically in the e-business market is very tough task to the customers due to day to day changes in various technical and operational parameter specifications like style, life of battery span, camera, radiation, RAM, ROM and cost etc. To choose and select a mobile in an optimized way, TOPSIS is one the selection procedure technique is adopted for this problem. This technique provides a base for decision - making processes where there are limited numbers of choices but each has a criteria of large number of attributes. In this paper some of the mobile manufacturer brands are considered with multiple criteria with various attributes and from an e-commerce website(s); which help us to select the best model and make of mobile using TOPSIS technique.*

Keywords—MCDM, Mobile Selection, Normalized decision matrix, Positive and Negative Ideal solutions, Ranking, Relative closeness, TOPSIS.

I. INTRODUCTION

Hwang and Yoon (1981) proposed that the ranking of alternatives will be based on the shortest distance from the Positive Ideal Solution (PIS) and the farthest from the Negative Ideal Solution (NIS)[1]. Hsu-Shih Shiha, et al (2007) investigated on extension of a Multi-Attribute Decision Making (MADM) technique, to a group decision environment. MajidBehzadian, et al (2012) had given review on state-of the-art survey of ―Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) applications [14]. The purpose of the TOPSIS technique is to recommend an item with certain criteria. In this paper the authors are proposed to implement TOPSIS algorithm for selection of mobile phone from various e-commerce websites. The paper is organized in four sections; in second section the methodology is used, the next section will deals with multi criteria selection model. The fourth section will provide the algorithm and experiment results and the last conclusion is given.

II. METHODOLOGY

The objective of this work is to develop TOPSIS method for Smart Mobile Phone(SMP) selection. In order to comply with collectingquantitative and qualitative data for TOPSIS Smart Mobile Phone (TSMP) selection model that could be applied by a seven steps approach was performed to ensure successful implementation[4] [9] [10] [12] [15] [16]. The user or reviewer can express their preferences and ratings to choose an item from a given e-commerce website supplier. These ratings are certainly based on multiple criterion attributes [1] [2] [3] [5] [6] [7] [8] of an item. The preferences and ratings are recorded or stored in the data base of that supplier; this helps a new user to see the reviews and decides whether the item can purchased or not. The ratings or reviews are collected and normalized with respect to attributes. Then decisions are standardized and finalized. So, before taking a decision of positive solution these decision values have to be normalized. Once if any user decides that to buy an item from a supplier then the user has to generate a dialogue consists set of decisions.

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III. SELECTION CRITERIA

In the current market, choosing and purchasing a new SMP is a big decision-making problem according to customer preferences. Customer choice must be made among several options for a given criteria, it is necessary to compare their performance characteristics in a proper methodology [1]. Someof the main criteria's of a mobile are style, life of battery span, camera, radiation, RAM, ROM and cost etc. The importance of these criteria is commonly known and here it is not elaborated.

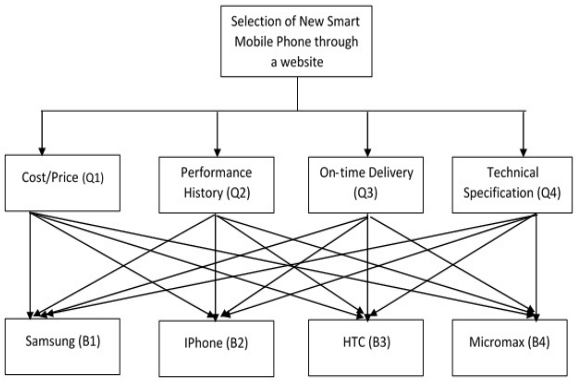

Fig.1: Selection process of smart mobile phone

In this paper, an attempt is made to choose a mobile based on Cost / Price (Q1) attribute. The attribute is applied on a selected item with user's reviews and compared in more than one e-commerce web sites, then the decision is made by applying TOPSIS algorithm to choose an item from the specified site.

IV. TOPSIS METHOD

TOPSISwas first presented by Yoon (1980) and Hwang and Yoon (1981) [1] [2] , for solving Multiple Criteria Decision Making (MCDM) [3] [5] [18] problems based on the concept that the chosen alternative should have the shortest Euclidian distance from the Positive Ideal Solution (PIS) and the farthest from the Negative Ideal Solution (NIS). For instance, PIS maximizes the benefit and minimizes the cost, whereas the NIS maximizes the cost and minimizes the benefit. It assumes that each criterion require to be maximized or minimized. TOPSIS is a simple and useful technique for ranking a number of possible alternatives according to closeness to the ideal solution.

The TOPSIS procedure is based on an intuitive and simple idea, which is that the optimal ideal solution, having the maximum benefit, is obtained by selecting the best alternative which is far from the most unsuitable alternative, having minimal benefits [3]. The ideal solution should have a rank of '1' (one), while the worst alternative should have a rank approaching '0' (zero). As ideal recommendations are not probable and each alternative would have some intermediate ranking between the ideal solution extremes. Regardless of absolute accuracy of rankings, comparison ofnumber of different Mobiles under the same set of selection criteria allows accurate weighting of relative mobile suitability and hence optimal mobile selection.

4.1 The TOPSIS method

Step 1:Establish the decision matrix.

Step 2: Calculate a normalized decision matrix.

Step 3:Determine the weighted decision matrix.

Step 4: Identify the Positive and Negative Ideal Solution (PIS & NIS).

Step 5: Calculate the separation distance of each competitive alternative from the ideal and non-ideal solution.

Step 6: Measure the relative closeness of each location to the ideal solution.

Step 7: Rank the preference order.

4.2 Experiment Results

Consider 3 suppliers (Websites namely flipkart, Amazon, snapdeal)…S1, S2, S3 who supplies the different brands of smart mobile phones with Samsung (B1), IPhone (B2), HTC (B3) and Micromax(B4) respectively.

3 suppliers are evaluated against 4 attributes … Special factor – Cost (Q1), On-time delivery (Q2), Performance history (Q3), Technical capability (Q4). Here Q1 is cost attribute; Q2, Q3 and Q4 are Benefit attributes.

There are 4 decision makers… D1, D2, D3, D4 are to express their preferences and ratings to select the best supplier.

Input Table

Table.1: Criterion parametric values

Attributes	Alternatives [for same type of mobile model with branding in e-commerce websites flipkart (S1), or Amazon (S2), orSnapdeal (S3)]			
	Samsung (B1)	iPhone (B2)	HTC (B3)	Micromax (B4)
Cost (Q1) in Rs	10,000/-	22,000/-	18,000/-	8,000/-
On-time delivery (Q2)	Better	Extreme	Better	Good
Performance (Q3)	Good	Extreme	Better	Good
Technical Specs (Q4)	Better	Extreme	Good	Good

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1. Finding attribute weights

Rating given to each attribute by each decision maker is shown in the following table.

Attributes	D_1	D_2	D_3	D_4	W=avg(D1..D4)	Normalized W
Q_1	H (7)	M (5)	ML (4)	VL (2)	4.5	0.276923
Q_2	VH (8)	VL (2)	VVL(1)	ML (4)	3.75	0.230769
Q_3	L(3)	VL (2)	VVL(1)	MH (6)	3	0.184615
Q_4	VH (8)	L(3)	M(5)	ML (4)	5	0.307692
Total					16.25	1.00

Scale of attribute weights are considered from 1 to 9 and notations from very-very-low to very- very-high.

2. Finding attribute ratings (Scale of attribute ratings from 1 to 9**)**

Rating given to each supplier by each decision maker for attribute Q1

Suppliers	D_1	D_2	D_3	D_4	G_1=avg(D1..D4)
S_1	.03	.03	.03	.03	.03
S_2	.05	.05	.05	.05	.05
S_3	.01	.01	.01	.01	.01

Rating given to each supplier by each decision maker for attribute Q2

Suppliers	D_1	D_2	D_3	D_4	G_2=avg(D1..D4)
S_1	.95	.95	.95	.95	.95
S_2	.98	.98	.98	.98	.98
S_3	.85	.85	.85	.85	.85

Rating given to each supplier by each decision maker for attribute Q3

Suppliers	D_1	D_2	D_3	D_4	G_3=avg(D1..D4)
S_1	G(9)	P(1)	MP(3)	MP(3)	4
S_2	MP(3)	MP&F(4)	MP&F(4)	MP&F(4)	3.75
S_3	F(5)	F(5)	MP&F(4)	F(5)	4.75

Rating given to each supplier by each decision maker for attribute Q4

Suppliers	D_1	D_2	D_3	D_4	G_4=avg(D1..D4)
S_1	G(9)	MP(3)	P(1)	MP(3)	4
S_2	MP(3)	MP&F(4)	F(5)	F(5)	4.25
S_3	G(9)	G(9)	MP&G(6)	MP&G(6)	8.5

3. Establish Decision Table

Suppliers	Attributes			
	Q_1	Q_2	Q_3	Q_4
S_1	.03	.95	4	4
S_2	.05	.98	3.75	4.25
S_3	.01	.85	4.75	8.5

Where Q1, Q2, Q3 and Q4 are values of G1, G2, G3 and G4 respectively.

4. Standardize decision table

Suppliers	Attributes			
	Q_1	Q_2	Q_3	Q_4
S_1	.508	.591	.551	.388
S_2	.845	.609	.517	.412
S_3	.169	.529	.655	.824

5. Weighted Standard Decision Table

Suppliers	Attributes			
	Q_1	Q_2	Q_3	Q_4
S_1	0.140	0.135	0.103	0.119
S_2	0.232	0.14	0.097	0.126
S_3	0.046	0.121	0.122	0.253

6. Construct The Positive Ideal Solution & Negative Ideal Solution.

Ideal Solutionis obtained by the following steps.

- **Minimum value** of **Cost Attributes** are Ideal.
- **Maximum value** of **Benefit Attributes** are Ideal.

Suppliers	Cost attribute	Benefit attributes		
	Q_1	Q_2	Q_3	Q_4
S_1	0.140	0.135	0.103	0.119

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S_2	0.232	(Max) 0.14	0.097	0.126
S_3	(Min) 0.046	0.121	(Max) 0.122	(Max) 0.253

Ideal solution = {0.046, 0.14, 0.122, 0.253}

Negative Ideal Solutionis obtained by the following steps.

- **Maximum value** of **Cost Attributes** are Negative Ideal.
- **Minimum value** of **Benefit Attributes** are Negative Ideal.

Suppliers	**Cost attribute**	**Benefit attributes**		
	Q_1	**Q_2**	**Q_3**	**Q_4**
S_1	0.14	0.135	0.103	(min.) 0.119
S_2	(max.) 0.232	0.14	(min.) 0.097	0.126
S_3	0.046	(min.) 0.121	0.122	0.253

Negative Ideal solution = {0.232, 0.121, 0.097, 0.119}

7. Construct the separation from positiveideal solution & negative ideal solution.

Separation from Ideal Solution Si*

Ideal solution = {0.046, 0.14, 0.122, 0.253}

	Cost attribute	**Benefit attributes**		
Suppliers	Q_1	Q_2	Q_3	Q_4
S_1	**(**0.14 - .046**)^2 = 0.009**	**(**0.135 - 0.14**)^2 = 0.000**	**(**0.103 - 0.122**)^2 = 0.0004**	**(**0.119 - 0.253**)^2 = 0.018**
S_2	**(**0.232 - .046**)^2 = 0.035**	**(**0.14 - 0.14**)^2 = 0.000**	**(**0.097 - 0.122**)^2 = 0.0006**	**(**0.126 - 0.253**)^2 = 0.016**
S_3	**(**0.046 - .046**)^2 = 0.000**	**(**0.121- 0.14**)^2 = 0.0004**	**(**0.122 - 0.122**)^2 = 0.000**	**(**0.253 - 0.253**)^2 = 0.000**

S_1* = $(0.009+0.00+0.0004+0.018)^{1/2}$ = 0.166

S_2* = $(0.035+0.00+0.0006\_0.016)^{1/2}$ = 0.227

S_3* = $(0.00+0.0004+0.00+0.0000)^{1/2}$ = 0.02

Separation from Negative Ideal Solution Si'

Negative Ideal solution = {0.232, 0.121, 0.097 0.119}

	Cost attribute	**Benefit attributes**		
Suppliers	Q_1	Q_2	Q_3	Q_4
S_1	**(**0.14 - 0.232**)^2 = 0.008**	**(**0.135 - 0.121**)^2 = 0.0002**	**(**0.103 - 0.097**)^2 = 0.0000**	**(**0.119 - 0.119**)^2 = 0.000**
S_2	**(**0.232 - 0.232**)^2 = 0.000**	**(**0.14 - 0.121**)^2 = 0.0004**	**(**0.097 - 0.097**)^2 = 0.0000**	**(**0.126 - 0.119**)^2 = 0.0001**
S_3	**(**0.046 - 0.232**)^2 = 0.035**	**(**0.121 - 0.121**)^2 = 0.000**	**(**0.122 - 0.097**)^2 = 0.0006**	**(**0.253 - 0.119**)^2 = 0.0179**

S_1' = $(0.008+0.0002+0.000+0.000)^{1/2}$ = 0.09

S_2' = $(0.00+0.0004+0.000+0.0001)^{1/2}$ = 0.022

S_3' = $(0.035+0.00+0.0006+0.0179)^{1/2}$ = 0.231

Calculate the Relative Closeness to Ideal Solution.

Closeness to ideal solution Ci* = Si' / (Si* +Si')

Criteria	S_1	S_2	S_3
S_i*	0.166	0.227	0.02
S_i'	0.09	0.022	0.231
S_i*+S_i'	0.256	0.249	0.251
S_i' /(S_i*+S_i')	0.09/0.256 **=0.351**	0.022/0.249 **=0.088**	0.231/0.251 **=0.920**

C_1* = 0.351

C_2* = 0.088

C_3* = 0.920

Rank the order of suppliers based previous calculations:

C3* > C1* > C2*→*Supplier$_3$> Supplier$_1$> Supplier$_2$

V. CONCLUSIONS

The proposed procedure for SMP selection is to find the best mobile among available ones in e-commerce websites market using of decision making method. After checking the aggregations on various process parameters under different circumstances, it is observed that the proposed model is rather simple to use and meaningful for aggregation of the process parameters. TOPSIS is applied to achieve final ranking preferences in descending order; thus allowing relative performances is compared. Therefore it is observed that S3 (Snapdeal) website is higher ordered ranking for the same brand or type of mobile.

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