DECISION SUPPORT SYSTEM SELECTION OF THE BEST ANDROID SMARTPHONE USING THE METHOD OF MOORA

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Abstract—In the current conditions of each person must have a smartphone due to a lot of activities are done online. These activities can be in the form of learning, purchasing, transportation, and so forth. Smartphones offered currently have various specifications, sometimes prospective buyers feel confused to choose a smartphone as what they need. To overcome the problems in the decision of the selection of the best android smartphone that is with the decision support system using the method of Multi-Objective Optimization based on Ratio Analysis (MOORA). In this study, the data collected based on the 100 questionnaires that were distributed. The criteria used, namely random access memory (RAM), camera, price, storage capacity, battery life, and screen size. The results of the calculation obtained in this study determine each brand and type of smartphone the best android. Expected in this study can help prospective buyers who are confused in choosing the best android smartphone.

Keywords: Decision Support System, Android Smartphone, MOORA Method.

Abstrak—*Dalam kondisi saat ini setiap orang pasti memiliki smartphone dikarnakan banyak sekali kegiatan-kegiatan yang dilakukan secara online. Kegiatan-kegiatan tersebut dapat berupa pembelajaran, pembelian, transportasi dan lain sebagainya. Smartphone yang ditawarkan saat ini memiliki spesifikasi baragam, terkadang calon pembeli merasa bingung untuk memilih smartphone yang seperti apa yang mereka butuhkan. Untuk mengatasi permasalahan dalam keputusan pemilihan smartphone android terbaik yaitu dengan sistem penunjang keputusan menggunakan metode Multi-Objective Optimization On the Basis Of Ratio Analysis (MOORA). Dalam Penelitian ini data yang dikumpulkan berdasarkan 100 hasil kuesioner yang disebar. Kriteria yang digunakan yaitu* random access memory *(RAM), kamera, harga, kapasitas penyimpanan, baterai, dan ukuran layar. Hasil perhitungan yang didapatkan dalam penelitian ini menentukan masing masing merk dan tipe smartphone android terbaik. Diharapkan dalam penelitian ini dapat membantu calon pembeli yang bingung dalam memilih smartphone android terbaik.*

Kata Kunci: *Sistem Penunjang Keputusan, Smartphone Android, Metode MOORA.*

INTRODUCTION

At this time the smartphone becomes a necessity and almost owned by any person anywhere in the world, a smartphone that exists today has a variety of types, prices, and specifications provided. But due to lack of information owned by the prospective buyer making the potential buyer the trouble in choosing a smartphone is desired and needed (Harsiti & Aprianti, 2017). The number of criteria that influence the several options that exist to make a potential buyer trouble (Latif & Susilo, 2018) in the choose a smartphone that suits your needs and their purchasing power (Sandika, Permanasari, & Sumaryono, 2014). Each of the mobile brands offers various types and features that are diverse to make the potential buyer be confused in choosing (Putra & Irawati, 2018).

The problems that occur on the user's difficulty in finding a smartphone because of the many types and brands of smartphones on the market (Khairina, Ivando, & Maharani, 2016). The features of the smartphone are almost similar to the type of smartphone with one another. So that consumers feel confident in determining a smartphone tailored to their needs (Sianturi, Pratama, Sulistiono, & Fachrizal, 2018). The other problem is the number of the specifications of the smartphones existing on the market make the potential buyer is difficult to choose (Indriani, 2018). Trust, experience, quality products and are more oriented on brands to be a strong factor for prospective buyers in the purchase of a smartphone (Hidayatulloh & Naf'an, 2018).

In determining an alternative to a problem MOORA has a level of high selectivity (Ulandari, 2020). Previous research using MOORA with 5

(five) criteria namely price, RAM, memory, processor, and camera concluded that MOORA is simple to use as a way to determine the choice of smartphone gaming (Muharsyah, Hayati, Setiawan, Nurdiyanto, & Yuhandri, 2018).

The purpose of this research is how to apply the method *Multi-Objective Optimization based on Ratio Analysis* (MOORA)(Binjori, Hutapea, Syahrizal, & Kurniasih, 2018) based on the six criteria for the selection of the best android smartphone for prospective buyers in buying an Android smartphone.

MATERIALS AND METHODS

In this study to obtain primary data the researcher distributing questionnaires to respondents where they are android smartphone users. This study uses the method *Multi-Objective Optimization based on Ratio Analysis* (MOORA) by considering the criteria *random access memory* (*RAM*), camera, price, storage capacity, battery life, and screen size. In the process method of MOORA has stages of work, namely the input value of the criterion, changing the values of criteria into a decision matrix, the normalization of the methods of MOORA, reduce the value of the maximax and minimax, decide the ranking of the results of the calculation of MOORA. The stages of the research conducted can be seen in figure 1.
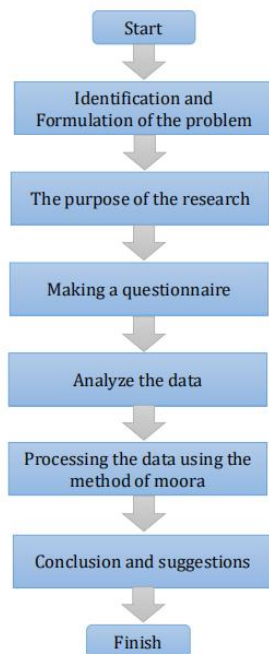
Source: (Al Hakim, Tuslaela, & Ernawati, 2020)
Figure 1. Stages Of Research

Based on the research conducted related to the assessment of the specifications on the android smartphone used by the user, then the method of

data analysis attention to the scale of assessment criteria that can be seen in table 1.

Table 1. The Scale Of Assessment

The predicate	The Weight Of Interest
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly Disagree	1

Source: (Al Hakim et al., 2020)

Here are the alternatives and the criteria used to determine the best android smartphone by using the method of MOORA can be seen in table 2 and table 3.

Table 2. Alternative

Alternative	Brand	Type
A1	Samsung	Samsung A50
A2	Samsung	J7
A3	Samsung	A50s
A4	Xiaomi	Redmi 8
A5	Vivo	Vivo Y93

Source: (Al Hakim et al., 2020)

Table 3. Criteria

Criteria	Description
K1	RAM
K2	Camera
K3	Storage Capacity
K4	Battery
K5	The Size Of The Screen
K6	Price

Source: (Al Hakim et al., 2020)

The Results Of The Questionnaire

The questionnaire was distributed to the respondent's users of android smartphones out in the territory of the City of Bogor, West Java. The population taken from the population-based on the Badan Pusat Statistik of the City of Bogor is 1.081.009 souls. To determine the number of samples required from a population the researchers used the Slovin formula (Umar, 2003), with the following formula:

$$n = \frac{N}{1 + N\,e^2} \quad \text{..} (1)$$

By using an error rate of 10% of the total population of 1.081.009 souls, then obtained a total sample of 99.99 then rounded up to 100 samples. Then the questionnaire distributed a total of 100 questionnaires. Data collection the questionnaire was conducted over three days. The results obtained for the data of respondents based on gender, age, and brands of android smartphone

that is used. Then the results of the data collection can be seen in table 4, table 5, and table 6.

Table 4. Gender Of Respondents

Gender	The Number Of Respondents	Percentage
Men	42	42%
Women	58	58%
Total	100	100%

Source: (Al Hakim et al., 2020)

Table 5. Age Of Respondents

Age Of Respondents	The Number Of Respondents	Percentage
17-21	10	10%
21-25	68	68%
25-35	15	15%
35-40	6	6%
>40	1	1%
Total	100	100%

Source: (Al Hakim et al., 2020)

Table 6. Brand Android Smartphone that was used by Respondents

Brand	The Number Of Respondents	Percentage
Xiaomi	20	20%
Samsung	20	20%
Vivo	20	20%
Asus	20	20%
Oppo	20	20%
Total	100	100%

Source: (Al Hakim et al., 2020)

Research Instruments
The research instrument can be seen in Table 7 below.

Table 7. Research Instruments

Criteria	Description	Indicators
RAM (*Random Access Memory*)	The larger the capacity of RAM on your android smartphone then it is much better and faster performance than the performance of the smartphone of the android.	Multitasking capability allows your android smartphone to work or open more than one application at one time. (adjust with your android smartphone).
Camera	The rapid advancement of technology so that smartphone users are increasingly fond of smartphones with the high quality of the camera.	The ability of the camera of your android smartphone to take photos with good quality photos. (adjust with your android smartphone)
Price	Price becomes a major	What is the price of an android

Criteria	Description	Indicators
	consideration in buying a smartphone.	smartphone that you use?
Storage Capacity	The magnitude of the storage capacity to accommodate the application and documents on your android smartphone.	The ability of the storage capacity of your android smartphone to store a lot of documents, applications, music, pictures, and video. (adjust with your android smartphone)
Battery	The magnitude of the battery capacity for the battery power consumption according to the usage of android smartphones.	The ability of the battery of your android smartphone in use for quite a long time. (adjust with your android smartphone)
The Size Of The Screen	The magnitude of the screen size to freely watch or shift the screen on your android smartphone.	The ability of the size of the screen to make the eyes on the visuals and your fingers for typing on your android smartphone. (adjust with your android smartphone)

Source: (Al Hakim et al., 2020)

The results of the questionnaire that has been distributed and filled based on the assessment of the respondents can be seen in table 8.

Table 8. The Results Of Data Research Instrument

No	K1	K2	K3	K4	K5	K6
1	5	4	5	5	5	3700000
2	4	3	3	2	5	3270000
3	4	4	3	4	5	3600000
4	5	5	5	5	5	1600000
5	5	5	5	5	5	3300000

Source: (Al Hakim et al., 2020)

RESULTS AND DISCUSSION

A. The Calculation Method Of *Multi-Objective Optimization based on Ratio Analysis*
Here are the stages of the completion of the calculation method of *Multi-Objective Optimization based on Ratio Analysis*, namely:

B. Assessment Criteria Weight
The following is the value of the weighting criteria used to determine the best android smartphone by using the method of MOORA. There are five criteria of benefit and the criteria for cost can be seen in Table 9.

Table 9. The value of the weight criteria

Kriteria Penilaian				
K1	RAM	31%	0.31	Benefit
K2	Camera	10%	0.1	Benefit
K3	Storage Capacity	25%	0.25	Benefit
K4	Battery	11%	0.11	Benefit
K5	The Size Of The Screen	7%	0.07	Benefit
K6	Price	16%	0.16	Cost
	Total	100%	1	

Source: (Al Hakim et al., 2020)

C. Assessment Criteria Each Alternative

The following are the assessment criteria of each alternative on the smartphone android can be seen in table 10.

Table 10. Assessment of Alternative

Alternative	K1	K2	K3	K4	K5	K6
1	5	4	5	5	5	3700000
2	4	3	3	2	5	3270000
3	4	4	3	4	5	3600000
4	5	5	5	5	5	1600000
5	5	5	5	5	5	3300000

Source: (Al Hakim et al., 2020)

Change The Value Of The Criteria Into Decision Matrix

$$X = \begin{bmatrix} x_{11} & x_{12} & x_{1n} \\ x_{21} & x_{22} & x_{2n} \\ x_{m1} & x_{m2} & x_{mn} \end{bmatrix} \dots \dots (2)$$

The following is a Decision Matrix:

$$\begin{vmatrix} 5 & 4 & 5 & 5 & 5 & 3700000 \\ 4 & 3 & 3 & 2 & 5 & 3270000 \\ 4 & 4 & 3 & 4 & 5 & 3600000 \\ 5 & 5 & 5 & 5 & 5 & 1600000 \\ 5 & 5 & 5 & 5 & 5 & 3300000 \end{vmatrix}$$

D. The Normalization Matrix

To calculate the normalization matrix using the formula below.

$$X^*ij = X_{ij} / \sqrt{\left[\Sigma_{i=1}^{m} X_{ij}^2 \right]} \dots \dots (3)$$

After the calculation of the normalization matrix for K1, resumed the calculation of the normalization matrix to K6. From the results of these calculations than can be seen the matrix is normalized as follows:

$$\begin{vmatrix} 0.1368 & 0.1077 & 0.1280 & 0.1281 & 0.1269 & 0.1066 \\ 0.1094 & 0.0808 & 0.0768 & 0.0512 & 0.1269 & 0.0942 \\ 0.1094 & 0.1077 & 0.0768 & 0.1025 & 0.1269 & 0.1037 \\ 0.1368 & 0.1346 & 0.1280 & 0.1281 & 0.1269 & 0.0461 \\ 0.1368 & 0.1346 & 0.1280 & 0.1281 & 0.1269 & 0.0950 \end{vmatrix}$$

Optimize attributes include the weights in search of the normalized

As the following calculation formula, namely:

$$Y_i = \Sigma_{j=1}^{g} w_j x_{ij}^* - \Sigma_{j=g+1}^{n} w_j w_{ij}^* \dots \dots (4)$$

The calculation to optimize the value of the attribute is calculated based on the formula below.

$$Y_1 = ((X_{11(max)} * W) + (X_{12(max)} * W) + (X_{13(max)} * W) + (X_{14(max)} * W) - (X_{15(max)} * W) - (X_{16(min)} * W) \dots \dots (5)$$

The result of the calculation to optimize the value of the attribute based on the formula above, the obtained value of 0.0911.

After the calculation of the normalization matrix weighted on Y1, continued back up to the calculation of the normalization matrix weighted up to Y100. The results of the calculation can be seen in the matrix below.

$$\begin{vmatrix} 0.0424 & 0.0108 & 0.0320 & 0.0141 & 0.0089 & 0.0170 \\ 0.0339 & 0.0081 & 0.0192 & 0.0056 & 0.0089 & 0.0151 \\ 0.0339 & 0.0108 & 0.0192 & 0.0113 & 0.0089 & 0.0166 \\ 0.0424 & 0.0135 & 0.0320 & 0.0141 & 0.0089 & 0.0074 \\ 0.0424 & 0.0135 & 0.0320 & 0.0141 & 0.0089 & 0.0152 \end{vmatrix}$$

Table 11 is the result of the calculation to get the value of max and min.

Table 11. Max and Min

Max (K1+K2+K3+K4+K5)	Min (K6)	Yi (Max-min)
0.1082	0.0170	0.0911
0.0757	0.0151	0.0607
0.0841	0.0166	0.0675
0.1109	0.0074	0.1035
0.1109	0.0152	0.0956

Source: (Al Hakim et al., 2020)

E. Ranking MOORA

The calculations have been ranked from the largest to the smallest based on the value of the Max-Min can be seen in table 12.

Table 12. The value of Max and Min

Altern ative	Brand	Type	Max	Min	Yi (Max-Min)
A1	Samsung	Samsung A50	0.1082	0.0170	0.0911
A2	Samsung	J7	0.0757	0.0151	0.0607
A3	Samsung	A50s	0.0841	0.0166	0.0675
A4	Xiaomi	Redmi 8	0.1109	0.0074	0.1035
A5	Vivo	Vivo Y93	0.1109	0.0152	0.0956

Source: (Al Hakim et al., 2020)

CONCLUSION

A decision support system using the method of Multi-Objective Optimization based on Ratio Analysis (MOORA) has been performed effectively based on six criteria that have been set, namely random access memory (RAM), camera, price, storage capacity, battery life, and screen size. The results of calculations obtained for the selection of the best android smartphone first is the Xiaomi Redmi 8 with the value of the results 0.1035, second best is the Samsung A20s with the value of the results of 0.1006, the third-best is the Samsung A20s with the value of the result 0.0977, the fourth-best is Xiaomi 5A with the results of 0.0971 and the best fifth is the Vivo Y93 with the value of the results of 0.0956.

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