SEAN INSTITUTE
Sharing Knowledge
http://infor.seaninstitute.org/index.php/infokum/index
JURNAL INFOKUM, Volume 10, No.01, December 2021 ISSN 2303.9706

Decision Support System For Selection Of Electric Light Ball For Household With Technique Method For Order Preference By Simillarity To Ideal Solution (Topsis)

Pandi Barita Nauli Simangunsong[1], Paska Marto Hasugian[2], Makmur Tarigan[3]

[1]Teknik Komputer, Politeknik LP3I Medan, Indonesia

[2]Teknik Informatika, Stmik Pelita Nusantara, Medan, Indonesia

[3]Politeknik Negeri Medan, Indonesia

Simangunsong.pandi@gmail.com

Abstract

Article Info
Received : 23/10/2021
Revised : 07/11/2021
Accepted : 01/12/2021

In the selection of these light bulbs, users are often confused with the choice of light bulbs that are so widely circulated in the market, ranging from brands, types, quality, prices that continue to compete and with other advantages on offer often make users confused to get Energy efficient light bulbs at affordable prices and with the best quality. The problem doesn't just stop there when placing light bulbs in each room of the house also often gets into trouble. The problem that is often caused is mismatch, this usually happens when the light bulb has been placed. The wattage capacity of the light bulb often does not match the size of the room, resulting in less than optimal lighting. Watt capacity or large power consumption sometimes also does not guarantee to be able to get good lighting. Therefore we need a decision support system that can calculate values to be able to help users determine the desired light bulb properly and precisely according to needs. This decision support system implements the technique for order preference by simillarity to ideal solution (TOPSIS) method, which is a method that can give weighting and ranking for each criterion. With the technique for order preference by simillarity to ideal solution (TOPSIS) method, the author creates a system that is expected to later be able to assist decision making in the selection of electric light bulbs.

Keywords: Electric Light Bulb, TOPSIS Method, and SPK

1. Introduction

Decision support system[1] In general, it can be defined as a system capable of providing problem solving capabilities[2]as well as communication skills for semi-structured problems. A decision support system in a point of view can also be described as a tool or tool to support decisions[3](Kadarsah Suryadi and Ali Ramdani, 2002:1). On the other hand, decision makers are often faced with the complexity and scope of decision making with so much data. For that purpose, most decision makers consider several ratios and costs, which are faced with a necessity to rely on a set of systems that are able to solve problems efficiently and effectively, which are then referred to as decision support systems (DSS).

For areas that have been fed electricity[4], In everyday life, of course, it cannot be separated from the lamp[5]. Lights are a must-have component in every home[6], to be able to provide an explanation[7] in every room of the house, [8]starting from the living room, bedroom, terrace, kitchen, lighting[9] on the study table and other rooms.

But in the selection of Light Bulbs[10] In this case, users are often confused with the choice of light bulbs that are so widely circulated in the market, starting from the brand, type, quality, price that continues to compete and with the other advantages that are offered, it often makes users confused about getting an efficient light bulb. energy [11]at an affordable price and with the best quality.

The problem doesn't just stop there when placing light bulbs in each room of the house also often gets into trouble. The problem that is often caused is mismatch, this usually happens when the light bulb has been placed. Watt capacity[12] the light bulbs often do not match the size of the room, resulting in less than optimal lighting, wattage capacity or large power consumption sometimes also does not guarantee to be able to get good lighting.

2. Method

In making a decision, humans are faced with various kinds of confusing choices, in making a decision of course the user as the decision maker assesses the positive and negative aspects of a decision to be taken. In terms of choosing an Electric Light Bulb[13], when society[14] If you want to choose a light bulb, of course, think about how the decision that will be taken later can be the right decision and in accordance with the needs needed in a house.

Given the problems that often occur in everyday life, and based on the needs above, the author intends to create a decision support system for the selection of Electric Light Bulbs which are expected to be able to help the community.[15]in making the right decision. The selection of this light bulb is based on existing criteria with a predetermined weight from the results of the analysis using the TOPSIS method.

To be able to get a good electric light bulb decision, there is an analysis that must be done to obtain alternative data and the criteria needed, here is the arrangement of alternative data and the criteria used that have been previously analyzed:

1. Electric Light Bulb Data
2.

Table 1. Data of 5watt Listrik Electric Light Bulbs

Brand	Price	Power Consumption	Room Size	Use Life	warranty

Hannochs 5watt	Rp.19,000	5 watts	4 M2	8,000 hours	12 months
Philips 5watt	Rp. 26,000	5 watts	6 M2	10,000 hours	18 Months
Osram 7watt	Rp. 18.000	7watt	9 M2	8,800 hours	24 Months
Kawachi 5watt	Rp. 16,500	5 watts	12 M2	6,000 hours	6 months

3. The light bulb data for each of the following room sizes is an example for a 4M . room size^{2}with alternatives Hannochs 5watt, Philips 5watt, Osram 7watt, and Kawachi 5watt. And so on for other room sizes.

Table 2 Electric Light Bulb Data For 4M2 . Room

Brand	Price	Power Consumption	Room Size	Use Life	warranty
Hannochs 5watt	Rp.19,000	5 watts	4M2	8,000 hours	12 months
Philips 5watt	Rp. 26,000	5 watts	4M2	10,000 hours	18 Months
Osram 7watt	Rp. 18.000	7 watts	4M2	8,800 hours	24 Months
Kawachi 5watt	Rp. 16,500	5 watts	4M2	6,000 hours	6 months

4. Alternative data for 5watt electric light bulbs that will be considered as recommendations can be seen in the following table of alternative electric bulbs:

Table 3. Alternatives to 5watt Electric Light Bulbs

Alternative	Information

A1	Hannochs 5watt
A2	Philips 5watt
A3	Osram 5watt
A4	Kawachi 5watt

4. Required Criteria Data

The criteria for the recommended electric light bulb are in accordance with what many consumers usually want based on a survey conducted previously.

Table 4. Data Criteria

Criteria	Information
C1	Price
C2	Power Consumption
C3	Room Size
C4	Use Life
C5	warranty

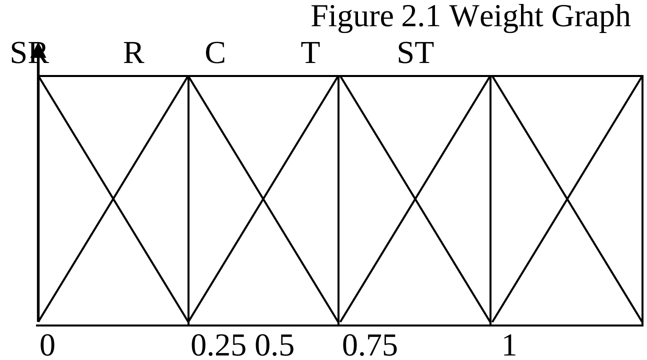
5. Based on these criteria, a criterion importance level is based on a predetermined weight value into a fuzzy number. Match rating

each alternative on each of the following criteria:

Very Low (SR) = 0
Low (R) = 0.25
Enough (C) = 0.5
Height (T) = 0.75
Very High (ST) = 1

The weight values are made in a graph to make it clearer, as in the graph below:

Figure 2.1 Weight Graph



Information :
SR = Very Low C = Fairly High ST = Very High
R = Low T = Height

6.Based on the criteria and the suitability rating of each alternative on each predetermined criterion, then each criterion weight is converted to a fuzzy number.

Table 5 Criteria Values and Preference Weights

Criteria	Score	Weight
Price	30	1
Power Consumption	25	0.8
Room Size	20	0.6
Use Life	15	0.4
Warranty	10	0.2

2.1 Analysis Using Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) Method.

The Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) method is one method of solving the Fuzzy Multiple Attribute Decision Making (FMADM) problem, so in solving the problem of assessing the selection of electric light bulbs using the Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) which in this case will provide recommendations for electric light bulbs with predetermined assessment criteria and weights. Criteria and weights are needed to perform calculations in the Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) method, so that the best alternative will be obtained. The alternative referred to in this case is a light bulb that has the highest value from the sum of all the criteria and a predetermined weight value.

Table 6. Alternatives to electric light bulbs with 4M2 . space

No	Alternative	Criteria				
		C1	C2	C3	C4	C5
1	A1	Rp.19,000	5watt	4M2	8,000 hours	12 months
2	A2	Rp. 26,000	5watt	4M2	10,000 hours	18 Months
3	A3	Rp. 18.000	7watt	4M2	8,800 hours	24 Months
4	A4	Rp. 16,500	5watt	4M2	6,000 hours	6 months

Based on the criteria of each alternative on each of the predetermined criteria, then the translation of the weight of each criterion has been converted to fuzzy numbers.

1.Price

Price is the criterion used for the assessment of each alternative light bulb that is considered, the predetermined assessment is converted into fuzzy numbers as shown in the following table:

Table 7 Price Conversion

Criteria	Fuzzy Numbers	Weight
C1 <= 18,500	Very High (ST)	1
C1 >= 19,000 – 23,000	Height (T)	0.75
C1 >= 24,000 – 30,000	Enough (C)	0.5
C1 >= 31,000 – 40,000	Low (R)	0.25
C1 > 40,000	Very Low (RS)	0

2. Power Consumption

Power consumption is a criterion used to assess how much power consumption is absorbed by a light bulb which is usually expressed in Watts, which is an alternative consideration. The determined assessment is converted into fuzzy numbers as shown in the following table:

Table 8. Conversion of Power Consumption

Criteria	Fuzzy Numbers	Weight
C2 <= 5watt	Very High (ST)	1
C2 > =7watt – 14watt	Height (T)	0.75
C2 > =15watt – 18watt	Enough (C)	0.5
C2 > =20watt – 23watt	Low (R)	0.25
C2 > 23watt	Very Low (SR)	0

3. Room Size

Assessment criteria The specified room size is converted into fuzzy numbers as shown in the following table:

Table 9. Room Size Conversion

Criteria	Fuzzy Numbers	Weight
C3 < 4M2	Very Low (SR)	0
C3 >= 4M2 – 6M2	Low (R)	0.25
C3 >= 7M2 – 10M2	Enough (C)	0.5
C3 >= 11M2 – 15M2	Height (T)	0.75
C3 >= 16M2	Very High (ST)	1

4. Use Life

The assessment of the specified service life criteria is converted into fuzzy numbers as shown in the following table:

Table 10. Conversion of Lifespan

Criteria	Fuzzy Numbers	Weight
C4 < 5,000 hours	Very Low (SR)	0
C4 >= 6,000 – 8,000 hours	Low (R)	0.25
C4 >= 8,500 – 8,800 hours	Enough (C)	0.5
C4 >= 8,900 – 9,900 hours	Height (T)	0.75
C4 > =10,000 hours	Very High (ST)	1

5. warranty

The determined warranty assessment is converted into a fuzzy number as shown in the following table:

Table 11. Warranty Conversion

Criteria	Fuzzy Numbers	Weight
C5 < 6 months	Very Low (SR)	0
C5 >= 6 months -11 months	Low (R)	0.25
C5 >= 12 months -18 months	Enough (C)	0.5
C5 >= 19 months – 23 months	Height (T)	0.75
C5 >=24 months	Very High (ST)	1

After all the descriptions of the weights of each criterion have been converted to fuzzy numbers. Then the next step is to make a ranking table for the suitability of the criteria assessment data based on the weight of the assessment that has been determined for each room and perform calculations to get the results of the decision. Here are the compatibility ranking tables and their calculations:

Table 12. Table of Room Suitability Ranking

No	Alternative	Criteria				
		C1	C2	C3	C4	C5
1	A1	0.75	1	0.25	0.25	0.5
2	A2	0.5	1	0.25	1	0.5
3	A3	1	0.75	0.25	0.5	1
4	A4	1	1	0.25	0.25	0.25

Next Forming a Normalized Decision Matrix

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}};$$

$X_1 = \sqrt{0{,}75^2 + 0{,}5^2 + 1^2 + 1^2}$

$= \sqrt{0{,}5625 + 0{,}25 + 1 + 1}$

$= \sqrt{2{,}8125}$

$= 1.6770509$

r1.1 = $\frac{x_{1.1}}{x_1} = \frac{0{,}75}{1{,}6770509}$ = 0,4472136

r1.2 = $\frac{x_{1.2}}{x_1} = \frac{0{,}5}{1{,}6770509}$ = 0,2981424

r1.3 = $\frac{x_{1.3}}{x_1} = \frac{1}{1{,}6770509}$ = 0,5962848

r1.4 = $\frac{x_{1.4}}{x_1} = \frac{1}{1{,}6770509}$ = 0,5962848

The calculation continues until the values of X2, X3, X4, and X5 are obtained so that from the above calculations, the R matrix values are obtained as follows:

$$R = \begin{pmatrix} 0.4472136 & 0.5298131 & 0.5 & 0{,}2132007 & 0.4 \\ 0.2981424 & 0.5298131 & 0.5 & 0{,}8528028 & 0.4 \\ 0.5962848 & 0.3973598 & 0.5 & 0{,}4264014 & 0.8 \\ 0.5962848 & 0.5298131 & 0.5 & 0{,}2132007 & 0.2 \end{pmatrix}$$

Determine the weighted normalized decision matrix:

$$y_{ij} = w_i r_{ij}$$

y1.1 = W1r1.1 = (1) (4472136) = 44721360,0,
y1.2 = W1r1.2 = (1) (2981424) = 29814240,0,
y1.3 = W1r1.3 = (1) (0.5656854) =0,5962848
y1.4 = W1r1.4 = (1) (0.5656854) =0,5962848

The calculation continues until the values of Y2, Y3, Y4, and Y5 are obtained so that from the above calculations, the Y matrix values are obtained as follows:

$$Y = \begin{pmatrix} 0.4472136 & 0.4238503 & 0.3 & 0.0852803 & 0.08 \\ 0.2981424 & 0.4238503 & 0.3 & 0{,}3411212 & 0.08 \\ 0.5962848 & 0.3178878 & 0.3 & 0.1705605 & 0.16 \\ 0.5962848 & 0.4238503 & 0.3 & 0.0852803 & 0.04 \end{pmatrix}$$

Next is to determine the positive ideal matrix
a. Positive Ideal Solution

$A^+ = Max\,(Y_1^+, Y_2^+, Y_3^+, \dots, Y_n^+)$

Y1+ = Max {4472136, 2981424, 0.5962848, 0.5962848 }0,0,
= 0.5962848

The calculation continues until the value of Y2+, Y3+, Y4+, and Y5+ is obtained so that the positive ideal value (A+) is as follows:
A+ = {0.5962848, 0.4238503, 0.3,3411212, 0.16} 0,
b. Negative Ideal Solution

$A^- = min\,(Y_1^-, Y_2^-, Y_3^-, \dots, Y_n^-)$

Y1- = Min {4472136, 2981424, 0.5962848, 0.5962848 }0,0,
= 29814240,
The calculation continues until we get the values Y2-, Y3-, Y4-, and Y5-
so that the positive ideal value (A-) is as follows:
A- = {2981424, 0.3178878, 0.3, 0.0852803, 0.04}0,

Next, determine the distance between the weighted values of each alternative to the positive ideal solution and the negative ideal solution.

a. Positive Ideal Solution

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_i^+)^2}$$

$$D_1^+ = \sqrt{\begin{array}{l}(0,4472136 - 0,5962848)^2 + (0,4238503 - 0,4238503)^2 + \\ (0,3 - 0,3)^2 + (0,0852803 - 0,3411212)^2 + \\ (0,08 - 0,16)^2\end{array}}$$

$$= \sqrt{(-0,1490712)^2 + (0)^2 + (0)^2 + (-0,2558409)^2 + (-0,08)^2}$$

$= \sqrt{(0,0222222) + (0) + (0) + (0,0654546) + (0,064)}$
$= \sqrt{0,0952888}$
= 0.3067193

The calculation continues until the values of D2+, D3+, and D4+ are obtained as follows: {0,3910099,}0,2007956, 0,3597978

b. Negative Ideal Solution

$$D_1^- = \sqrt{\begin{array}{l}(0,4472136 - 0,2981424)^2 + (0.4238503 - 0,3178878)^2 + \\ (0,3 - 0,3)^2 + (0,0852803 - 0,0852803)^2 + \\ (0,08 - 0,04\})^2\end{array}}$$

$$= \sqrt{(0,1490712)^2 + (0,1059627)^2 + (0)^2 + (0)^2 + (0,04)^2}$$

$= \sqrt{(0,0222222) + (0,0112281) + (0) + (0) + (0,0016)}$
$= \sqrt{0,0350502}$
= 0.1872171

The calculation continues until the values of D2-, D3-, and D4- are obtained as follows: }{ 0,2729900, 0,3325078, 0,4414198

The last step Determine the preference value for each alternative

$$V = \frac{D_i^-}{D_i^- + D_i^+}$$

$$V_1 = \frac{0.1872171}{0.1872171 + 0.3067193} = \frac{0.1872171}{0,4939364} = 0,3790307$$

$$V_2 = \frac{0.2797903}{0.2797903 + 0.3086889} = \frac{0.2797903}{0,5884783} = 0.4754463$$

$$V_3 = \frac{0,3325078}{0,3325078 + 0,2007956} = \frac{0,3325078}{0,5333034} = 0,6234871$$

$$V_4 = \frac{0.3164126}{0.3164126 + 0.2825855} = \frac{0.3164126}{0,5989981} = 0,5282364$$

Table 13. Preference values for each alternative

Alternative	Preference Value
A1	0,3790308
A2	0.4754463
A3	0,6234870
A4	0,5282364

Alternatives are ranked based on the preference value possessed by each alternative, from the table of preference values above, the ranking can be formed as follows:

Table 14. Ranking Results based on preference values

Rank	Alternative	Preference Value
1	A3	0,6234871
2	A4	0,5282364
3	A2	0,4754463
4	A1	0,3790308

The greatest value is in V3 so that the alternative A3 (Osram 7watt) is the alternative that was chosen as the best alternative. The best alternative will be used as the best light bulb recommendation to consumers.

3. Results and Discussion

3.1 Implementation Design

The implementation design is an overview of the program when it is designed in a programming language, the application used in this household electric light bulb decision support system uses the Visual Basic.net 2008 programming language, the following is a design drawing in Visual Basic.net 2008:

special interface design for admin, where only an administrator can use this form where this login form contains Username and Password to enter the admin menu.

Alternative input form for light bulb data The light bulb data input form is a special design form for admins, where admins can add light data, edit, and delete the following design form:

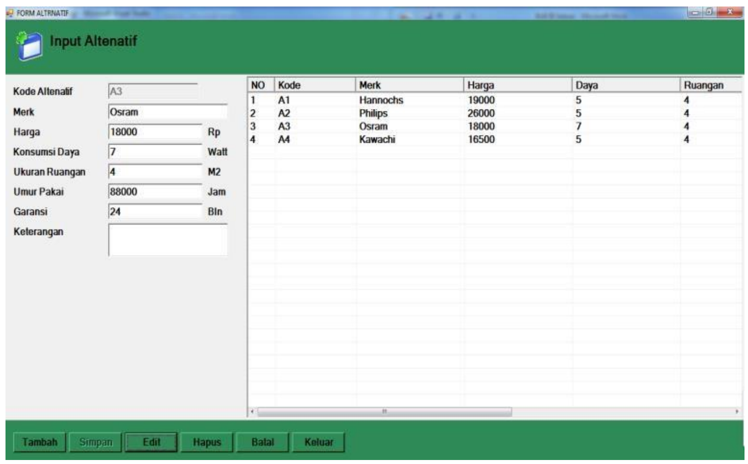


Figure 1. Lightbulb Data Input Form

Criteria Data Input Form The Criteria Data Input Form is a special design form for admins, where admins can add criteria data, edit, and delete the following is an image of the form design:

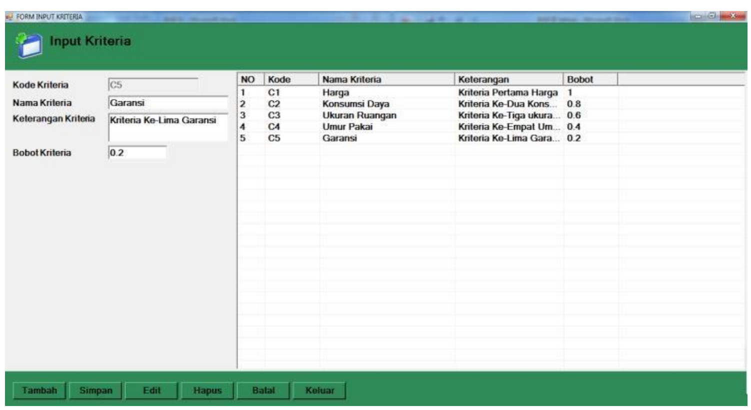


Figure 2. Criteria Data Input Form

Fuzzy Value Weight Input Form The value input form is a special admin design menu form, where the admin can add value data, edit, and delete. The design of the value weighting form is as follows:

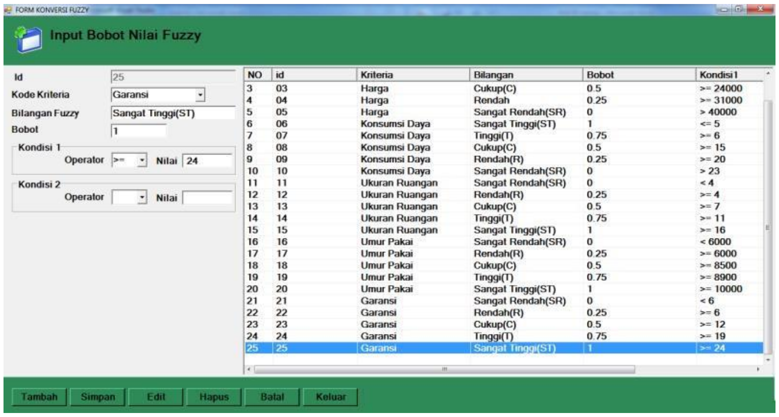


Figure 3. Input Form Value Weight

SPK Process Interface Form This form is a calculation process to get a good light bulb that suits your needs

Table 15. Result From Criteria

No	Kode	Merk	Harga	Daya	Rng	Umur	Grns	Hasil	Keterangan
1	A5	Hannochs	23,000	8	12	8,000	12	0.5380207	
2	A3	Osram	18,000	7	4	8,800	24	0.4425278	
3	A4	Kawachi	16,500	5	4	6,000	6	0.4017283	
4	A2	Philips	26,000	5	4	10,000	18	0.3835374	
5	A1	Hannochs	19,000	5	4	8,000	12	0.2791159	

4. Conclusions

From the results of the research that has been done, it can be determined what are the criteria and what are alternatives in choosing electric light bulbs for households. By applying the technique for order preference by simillarity to ideal solution (TOPSIS) method, it can provide good decision results in the problem of choosing an electric light bulb which consists of several alternative light bulbs. Based on the criteria that have been taken into consideration. With the application of a decision support system for choosing an electric light bulb for this household, it can make it easier for consumers to choose a good electric light bulb that suits their needs.

.

Reference

[1] Z. Alamsyah and D. Gustian, "Decision Support System Using Weighted Product And Simple Additive Method," Sist. Decision Support Using Methods. Weight. Prod. Dan Simple Addit., 2019.
[2] A. Setiawan, “Self-Disclosure and Problem-Solving Ability,” J. Psikol., vol. 6, no. 1, 2019.
[3] LN Hidayat, "TOPSIS Method To Help Selection Of Majors In High School," J. Univ. Dian Nuswantoro, 2014.
[4] YI Nakhoda and C. Saleh, “VERTICAL AXIS WIND POWER PLANT FOR HOUSEHOLD LIGHTING IN COASTAL AREA,” Inst. Technol. Nas. Unfortunately, vol. 7, no. 1, 2017.
[5] S. Palaloi, E. Nurdiana, and A. Wibowo, “PERFORMANCE TESTING AND ANALYSIS OF LED TL LIGHTS FOR GENERAL LIGHTING,” J. Stand., vol. 20, no. 1, 2018, doi:10.31153/js.v20i1.680.
[6] I. Kurniawan, “Home Appliances Control System Based on Blynk and NodeMCU ESP8266 Applications,” Yogyakarta, 2017.
[7] W. Anhar, B. Basri, M. Amin, R. Randis, and T. Sulistyo, "Calculation of Street Lighting Based on Solar System," JST (Jurnal Sains Ter., vol. 4, no. 1, 2018, doi: 10.32487/jst.v4i1.449.
[8] M. Hudori and Y. Paisal, "Design of Automatic Lighting Control System in Residential Houses to Increase Efficiency of Electricity Consumption," Ind. eng. J., vol. 8, no. 1, 2019, doi:10.53912/iejm.v8i1.375.
[9] D. Eridani, MA Asyauqqi, and AB Prasetijo, "Analysis of Prototypes of Street Lighting Automation Systems to Save Electricity," J-SAKTI (Journal of Computing and Inform. Science, vol. 4, no. 1, 2020, doi: 10.30645/ j-sakti.v4i1.194.
[10] DY Fallo, “NAVE BAYES METHOD FOR PREDICTING HOUSEHOLD ELECTRICITY USE,” J. Educator. Technol. Inf., vol. 1, no. 2, 2018, doi:10.37792/jukti.v1i2.11.
[11]N. Wahyuni, S. Syaifurrahman, and J. Islami, “Installation of Household Scale Solar Power Plants with Energy-Efficient Led Dc Lamps for Remote Communities in Kubu Raya Regency, West Kalimantan,” J-ABDIPAMAS (Jurnal Pengabdi. Kpd. Masyarakat), vol. 3, no. 2, 2019, doi:10.30734/j-abdipamas.v3i2.570.
[12]H. Asy'ari, A. Rozaq, and FS Putra, “Utilization of Solar Cells with PLN as a Source of Residential Electricity Energy,” Emit. J. Tech. Electrical, vol. 14, no. 1, 2014, doi:10.23917/emitor.v14i1.12775.
[13] IBK Sugirianta, IGNA Dwijaya Saputra, and IGAM Sunaya, “Inverter Based On-Grid PLTS Practice Module,” Matrix J. Manaj. Technol. and Inform., vol. 9, no. 1, 2019, doi:10.31940/matrix.v9i1.1168.
[14]N. Margolang, “COMMUNITY EMPOWERMENT,” Dedik. J. Community Engag., 2018, doi: 10.31227/osf.io/weu8z.
[15]P. Chen, “Effects of normalization on the entropy-based TOPSIS method,” Expert Syst. Appl., vol. 136, 2019, doi:10.1016/j.eswa.2019.06.035.