

Implementation of Multi-Criteria Decision Making (MCDM) for new student majors recommendations

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Abstract

The major selection that is suited to capacity is one way for students to be able to complete their studies at college. The mistake in choosing majors is a problem that is often experienced by students. Many students are confused and careless in choosing a major, some choose a major based on the wishes of their parents or following a friend, so during the lecture process there are many obstacles to achieve a bachelor's degree, even having to take education until the end of the study period. Multi-Criteria Decision Making is one way that can be used to help recommend prospective students based on their abilities. The program is made specifically for Android-based Smartphones, so that prospective students can try to choose based on values that match the criteria determined by the desired major without having to feel afraid or embarrassed to know whether to be accepted into the department or not. So with the creation of this system, it is expected to be able to provide recommendations to prospective students in choosing majors that are following their academic abilities and effective study time.

Keywords: Major Recommendation; Multi-Criteria Decision Making (MCDM); Android Based

I. INTRODUCTION

The mistake in choosing a major or study program are a problem that prospective students often face. It can be experienced by new students or old students, because they feel that they have chosen the wrong major. In the end, they are lazy or have difficulty in lectures or writing a thesis. Perhaps, once it is proved that the wrong major is mistaken. It will have a bad impact in the future, resulting in students not being able to finish college (drop out) or getting less than optimal results with a long lecture time.

Higher education is a continuation of secondary education. It is prepared for students to become members of the community who have academic and professional abilities. They should be able to apply, develop and create science, technology, and art as stated in Law 2 of 1989, article 16, paragraph (1) and develop and disseminate science, technology, and art as well as optimize their use to improve people's living standards and enrich the national culture as stated in Law 2 of 1989, Article 16, Paragraph (91); PP 30 of 1990, Article 2, Paragraph (1). [1]

In general, high school students or the equivalent would like to continue to a higher level of education at a college. They should choose a study program that is suitable for their future aspirations. However, prospective students will usually only choose majors because of their friends or the will of their parents. The prospective students never take into account their capacities based on academic scores obtained during their studies during high school or the equivalent. Therefore, while attending the lecture from the beginning, they experience problems, namely not understanding the material given during lectures, especially when entering majors or concentration courses. This makes them unable to achieve graduation on time or unable to finish college (drop out). This usually becomes a factor of the decline in enthusiasm for learning in college. The decision-making process by decision-makers in difficult situations, limited time, and uncertain conditions are needed (Jaya et al, 2020).

Based on the problems above, it is necessary to create a system. The recommendation system for selecting majors using the Multi-Criteria Decision Making (MCDM) method is expected to be able to provide input to prospective students. The system was developed using the Android-based and Multi-Criteria Decision Making (MCDM) method.

II. LITERATURE REVIEW

Multi-Criteria Decision Making (MCDM) is one of the most widely used methods in the decision-making area. The purpose of MCDM is to select the best alternative from several mutually exclusive alternatives based on general performance in various criteria (or attributes) determined by the decision maker. There are four decision-making steps in MCDM [7] including 1. Problem identification. 2. Develop preferences. 3. Evaluate alternatives. 4. Determine the best alternative. Suppose there are m criteria (C_1, \dots, C_m) and n alternatives (A_1, \dots, A_n). MCDM

problems are usually represented in the form of a decision table as shown in Figure 1. The a_{ij} value shows the alternative performance score A_j on the C_i criterion which is the preference of the decision maker. Each criterion has a weight of w_i which indicates the level of importance of the C_i criteria in the decision-making process (Agung et al, 2015).

		A_1	.	.	A_n
w_1	C_1	a_{11}	.	.	a_{n1}
.
.
w_m	C_m	a_{m1}	.	.	a_{mn}

Figure 1. Decision Table

The A_{ij} value shows the alternative performance score A_j on the C_i criteria which is the preference of the decision maker. Each criterion has a weight of w_i which indicates the level of importance of the C_i criteria in the decision-making process (Agung et al, 2015). The Multi-Criteria Decision Making (MCDM) method uses multiplication to connect attribute ratings, where the rating of each attribute must be raised to the first power with the weight of the attribute in question. The steps in using this method are:

1. Determine the criteria that will be used as a reference in making decisions.
2. Determine the suitability rating of each alternative on each criterion.
3. Determine the preference weight of each criterion.
4. Multiply all attributes for an alternative with the weight as a positive power for the benefit attribute and the weight with a negative power for the cost attribute.
5. The multiplication results are added together to produce a V value for each alternative.
6. Find alternative values by performing the same steps as in step one, and only use the highest value for each attribute; the highest value for each benefit attribute, and the lowest value for the cost attribute.
7. Divide the value of V for each alternative by the standard value ($V(A^*)$) which yields R .
8. Find the ideal alternative value [1].

After the method used has been determined, the next step is to determine the tools to be used, where this decision support system is designed as a desktop application with the tools used, namely Android and MySQL-based programming.

III. METHOD

Multi-Criteria Decision Making (MCDM) is concerned with structuring and solving decision and planning problems involving several criteria. Its purpose is to support decision-makers in dealing with these problems. Usually, there is no unique optimal solution to such a problem, and it is necessary to use the preferences of the decision-maker to distinguish between solutions.

Solving can be interpreted in different ways. It can correspond to selecting the best alternative from a set of available alternatives. Other interpretations of the solution could be selecting a small set of good alternatives or grouping the alternatives into different sets of preferences. The extreme interpretation may be to find all alternatives that are efficient or not dominated.

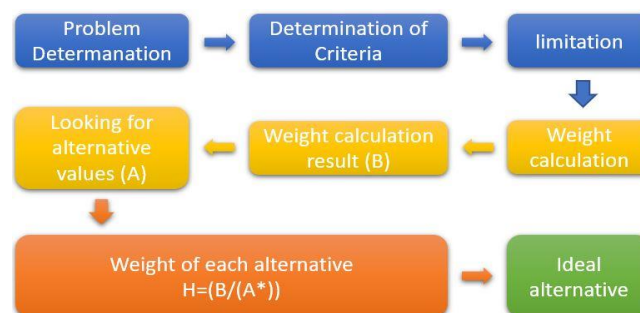


Figure 2. Process Flow

The difficulty of the problem stems from the existence of more than one criterion. No more unique optimal solutions to MCDM problems can be obtained without entering preference information. The concept of an optimal solution is often replaced by an undominated solution set. A solution is called nondominated if it is not possible to improve it on any criterion without sacrificing it on any other criterion. Therefore, it makes sense for the decision maker to choose a solution from the non-dominated set. Otherwise, he could do better on some or all of the criteria, and not do worse on any of them. Generally, however, the set of nondominated solutions is too large to be presented to the decision maker for the final choice. We, therefore, need tools that help decision-makers focus on preferred (or alternative) solutions. Usually, one must trade certain criteria for someone else.

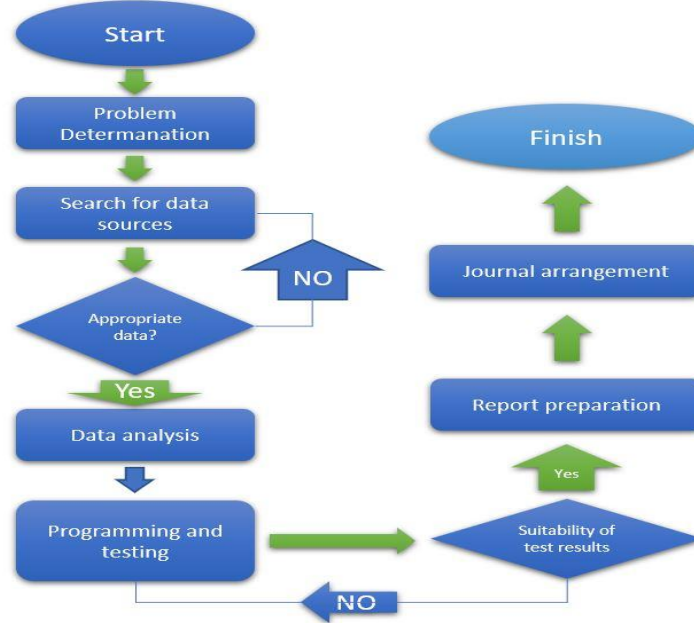


Figure 3. Research Flow

The system to be built is a system consisting of a computer server that functions as a data processing model and as a database server, an Android phone that functions as a client that will be used by users to input and process data using the MCDM method. The process will start from the android phone that is used by prospective students to determine the destination study program and enter a value. The value that has been entered will be stored in a database located on the server computer which will then be calculated. After all, the data has been successfully entered the user presses the corresponding process button. If it is on a cellphone, the calculation process using the Multi-Criteria Decision Making (MCDM) method will be carried out on the user's cellphone based on the parameters and value variables used, then prospective students will know the results of whether the desired study program matches the value entered or not. The process flow of the Multi-Criteria Decision Making (MCDM) program can be seen in Figure 4.



Figure 4. MCDM Process Flow

IV. RESULTS AND ANALYSIS

The test results are used to determine whether prospective students can be accepted into the desired study program by using the Multi-Criteria Decision Making Application (MCDM App) which is built based on Mobile (Android Application). Applications are used to find out whether prospective students can be accepted into the desired study program with the parameters that exist in the study program of interest. The prospective students who will take an existing study program at the Yogyakarta Technological University (UTY) are asked to enter the value. The value is based on the criteria, parameters, and sub-parameters that have been determined by the study program. The value is later used to compare the final calculation results with existing standard values on the study program. The criteria, parameters, and sub-parameters between one study program and another are made different according to the standards that exist in the study program.

The Multi-Criteria Decision Making (MCDM) method is used to calculate criteria that have been entered previously or are commonly referred to as parameters. In this trial, the parameters used are Grade XII Report Cards, Interviews, Academic Achievements, and Psychological Tests, where parameters can be increased or decreased according to the needs of the study program. In addition, each parameter also has a sub-parameter that is used to perform calculations. MCDM is based on variables or standard values determined for each study program.

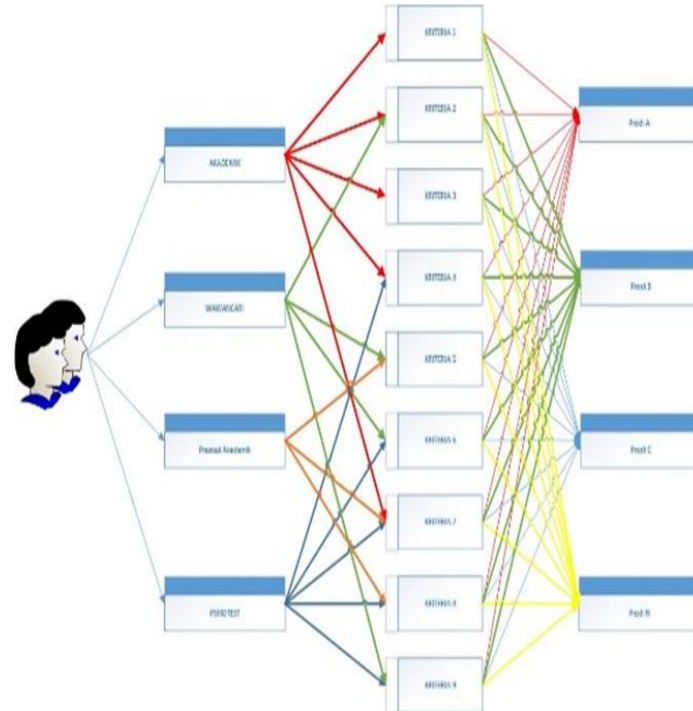


Figure 5. MCDM Process

A. Business process

The criteria used to perform the calculations are divided into several sections where each section has different criteria for each study program. To be accepted into the desired study program, the prospective students must reach the minimum value limit that must be met where the value limit is obtained from the previous supporting calculations. The following is an example of a value limit table that will be used as a standard value in the desired study program.

The determination of criteria is determined by calculating parameters based on the values entered by prospective students, where the criteria and value calculations have been set by the study program officer whose function is to determine the initial value. The following is the initial calculation formula.

$$NI = PI * N \quad (1)$$

Information:

NI = Value calculation result with the first criteria

PI = The first parameter determined by the production officer

N = Value entered by prospective students

An example of the initial calculation results in determining the final value can be seen in table 3 where the result column is obtained from the value column multiplied by the percentage value column. After the initial calculation has been carried out, the next process is the parameter calculation based on the total value generated from the initial calculation. Table 4 shows the value criteria that will be multiplied by the results of the previous calculation. The calculation formula can be seen in formula 2 as below.

$$N2 = \text{sum}(P2) * N1 \quad (2)$$

The next calculation is to add up the results of the calculation process based on the existing parameters multiplied by the percentage value that has been previously determined by the study program officer. The example of the second calculation results in determining the results of parameter calculations can be seen in Table 5

The final stage is to compare the total value generated by the parameter calculation with a minimum value limit for the intended study program. The minimum value for each study program can be seen in Table 1 in the Minimum Value column. The process of checking whether prospective students can be accepted into the desired study program can be done by using the If function in the program. The If formula can be seen in 3rd. formula

$$H = \text{if}(N2 \geq P3; H1; H2) \quad (3)$$

Information

- H = Final Result
- N2 = Value resulting from the calculation of Parameter
- P3 = Minimum value of study program
- H1 = Result if N2 >= P3
- H2 = Result if N2 <= P3

TABLE I. MINIMUM VALUE OF STUDY PROGRAM

Study Program Code	Name of Study Program	Accreditation	Minimum Score
P001	Sistem Informasi D3	A	70
P002	Sistem Informasi S1	B	65
P003	Informatika	A	80
P004	Sistem Komputer	B	65
P005	Elektro	B	65

TABLE II. PARAMETER VALUE

Parameter Code	Name of Parameter	Percentage
P0001	Akademik	35
P0002	Psikotest	20
P0003	Wawancara	25
P0004	Prestasi Akademik	20

TABLE III. EXAMPLES OF CALCULATIONS PER PARAMETER

Name of Parameter	Percentage Value	Initial sum result	Multiplication Result
Akademik	35	74,3	26,005
Prestasi Akademik	20	60	12
Psikotest	20	75	15
Wawancara	25	78,75	19,6875
Total			72,6925

TABLE IV. STUDY PROGRAM VALUE CRITERIA

Name of Prodi	Name of Parameter	Name of Kriteria	Percentage Value
Elektro	Akademik	Bahasa Indonesia	0,05
Elektro	Akademik	Bahasa inggris	0,05
Elektro	Akademik	Fisika	0,25
Elektro	Akademik	IPA	0,15
Elektro	Akademik	Kemampuan Analisa	0,1
Elektro	Akademik	Kimia	0,05
Elektro	Akademik	Kreativitas	0,1
Elektro	Akademik	Matematika	0,2
Elektro	Akademik	Kemampuan Sosial	0,05
Elektro	Psikotest	Kemampuan Sosial	0,65
Elektro	Psikotest	Kemampuan interaksi	0,35
Elektro	Wawancara	Pengambilan Keputusan	0,25
Elektro	Wawancara	Kemampuan interaksi	0,25
Elektro	Wawancara	Kemampuan Analisa	0,5
Elektro	Prestasi Akademik	Kreativitas	0,25
Elektro	Prestasi Akademik	Pengambilan Keputusan	0,2
Elektro	Prestasi Akademik	Kemampuan interaksi	0,3
Elektro	Prestasi Akademik	Kemampuan Sosial	0,25

TABLE V. INITIAL CALCULATION RESULTS

Name of Prodi	Name of Parameter	Name of Kriteria	Percentage Value	Value	Results
Elektro	Akademik	Bahasa Indonesia	0,05	85	4,25
Elektro	Akademik	Bahasa inggris	0,05	85	4,25
Elektro	Akademik	Fisika	0,25	75	18,75
Elektro	Akademik	IPA	0,15	70	10,5
Elektro	Akademik	Kemampuan Analisa	0,1	69	6,9
Elektro	Akademik	Kimia	0,05	56	2,8
Elektro	Akademik	Kreativitas	0,1	26	2,6
Elektro	Akademik	Matematika	0,2	100	20
Elektro	Akademik	Kemampuan Sosial	0,05	85	4,25
Elektro	Psikotest	Kemampuan Sosial	0,65	75	48,75
Elektro	Psikotest	Kemampuan interaksi	0,35	75	26,25
Elektro	Wawancara	Pengambilan Keputusan	0,25	85	21,25
Elektro	Wawancara	Kemampuan interaksi	0,25	80	20
Elektro	Wawancara	Kemampuan Analisa	0,5	75	37,5
Elektro	Prestasi Akademik	Kreativitas	0,25	75	18,75
Elektro	Prestasi Akademik	Kemampuan interaksi	0,3	75	22,5
Elektro	Prestasi Akademik	Kemampuan Sosial	0,25	75	18,75

V. CONCLUSION

Based on the application of the Multi-Criteria Decision Making method on android-based smartphones, they are:

1. Prospective students can do calculations on their abilities based on the results of report cards, interviews, and psycho tests
2. Prospective students can be calmer in determining the study program because they have received a recommendation from the program
3. Prospective students can try more than one study program to try to calculate the value to provide recommendations for other study programs

4. Study program officers can determine the criteria for prospective students according to the quality of prospective students

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