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Decision Support System for Selecting Marching Band Field Commanders Using Profile Matching

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A B S T R A C T

The selection process for Marching Band field commanders often relies on subjective evaluations such as the coach's feelings or other perceptions that lack objectivity. Therefore, a more systematic and objective approach is required to choose the most suitable marching band field commander. This research aims to establish a Decision Support System using the Profile Matching method. The development methodology employed was the Waterfall model, encompassing five steps: requirements, design, development, testing, and deployment. The research findings revealed three crucial aspects in determining the marching band field commander: body posture, field ability, and personality. Various criteria were utilized, including body language, preparedness, knowledge of marching rules, vocal skills, general understanding of marching bands, accuracy, experience, attitude, and presence. To facilitate the selection process, a decision support system application was developed using the PHP programming language. This system utilizes a database to store processed data and generates output in the form of rankings. The implementation of this decision support system resolves the challenge of determining the best marching band field commander, providing marching bands with a more objective means of identifying the ideal candidate.

1. Introduction

Music ensembles can offer functions that align with students' psychological needs for connection and belonging [1]. One of the musical ensembles is the marching band. A marching band is a musical ensemble performed while marching, often on a football field or other large open space. Marching bands usually include instruments such as brass (PIT), wind instruments (Ensemble), and percussion (Battery), as well as members of the Color Guard who perform with flags, rifles, and swords. Marching bands originated in the United States in the late 19th and early 20th centuries. The marching band began as a military tradition, namely with military band performances at parades and ceremonies. However, Marching Bands soon spread to high schools and colleges, where the group's activities became a popular activity for students. Currently, many secondary schools and universities are helping to provide a platform to help pupils and students channel their skills by establishing extracurricular or marching band student activity units.

A marching band is a musical group consisting of musical instrument players who walk and perform dances in an organized formation. One of the important roles in a marching band is that of the field commander, whose job is to direct the movements and dances of the marching band members so that they

look orderly, harmonious, and attractive to the audience. The majorette's job is to lead the marching band, while the field commander's job is to lead, command, and direct the marching band musicians in playing the song [2]. As a leader, the field commander must have high musical skills, experience in marching band, good communication skills, and other criteria. Selecting a marching band field commander is an important and crucial process in producing a successful marching band performance. Decision-making in selecting marching band field commanders is often based on feelings from the coach or other subjective perceptions that tend to be less objective. Therefore, a more systematic and objective approach is needed to select the most appropriate marching band field commander. Majorettes and field commanders are very important players in the field. Majorettes and Field Commanders serve as conductors or marching band leaders. Therefore, a majorette and field commander must have authority and a great leadership spirit to make the marching band look good [3].

Decision Support Systems (DSS) are information systems used to assist decision-making in an organization or company. DSS is designed to facilitate complex decision-making processes by providing structured and relevant information. In SPK, data and information are processed using mathematical or statistical methods to produce recommendations or decision options that can assist decision-making [4]. The goal is to help the Marching Band maintain its performance and championship performance by presenting the best Field Commander. The SPK method allows more objective and effective decision making by considering various relevant factors and criteria in the decision making process.

The application of the method used in developing a decision support system for selecting Marching Band field commanders is the Profile Matching method. According to Purwanto [5] Profile Matching is a decision-making mechanism, especially in human resource management, to determine a position with predetermined qualifications. The profile-matching process begins with selecting the required criteria and assigning a target value to each aspect. The next stage is a comparison between individual abilities and predetermined qualifications so that a GAP is obtained, where the smaller the score is obtained, the greater the weight of the score. According to Kusnadi [5], the profile matching process is broadly a process of comparing individual competencies with job competencies so that differences in competency can be identified (also called GAP). The smaller the GAP produced, the greater the weight of the value. It means that there is a greater opportunity for employees to occupy that position. So, to assist the marching band in determining the best field commander, a decision support system is needed by applying the profile matching method.

This Decision Support System was designed to improve previous research conducted by Nurjannah and Dito Putro Utomo entitled 'Decision Support System for Color Guard Selection in the Ginada Marching Band Using the Vikor and Borda Method', where the criteria used in the research only focused on height, weight, agility, stamina, and body language [6]. Apart from that, this research also complements and perfects previous research from I Putu Dody Suarnatha with the title 'Decision Support System for Selection of BEM Chairmen Using the Profile Matching Method'. In this research, three aspects of criteria were used, namely the academic aspect with sub-criteria GPA, vision and mission, semester, and achievement. Then non-academic aspects with recommendation sub-criteria, age, participation in non-campus organizations, and non-academic achievements finally, the attitude and behavior aspect, with the sub-criteria of leadership, integrity, loyalty, and cooperation [7]. By adding criteria to this research, it is hoped that it can increase the accuracy of the cafe selection decision support system compared to previous research.

2. Method

2.1. Method of Collecting Data

In collecting the data needed for this research, several methods were used. They are : (a) interview, which was conducted with the aim of obtaining more detailed and definite information about the research carried out. This aims to collect information that will be useful in making an analysis of selecting the best

field commander; (b) observation is a data collection technique by carrying out direct observation and systematic recording of the objects studied. Observations were carried out by observing the selection process for selecting Marching Band Field Commanders; (c) literature studies were carried out to understand and study existing documents, starting with supporting references from journals, books, and sources related to research that can support the research object, as well as a list of assessments of participants in the Marching Band Field Commander selection.

2.2. System Development Methods

This research used the waterfall method as a system development method. The reason for using this method is because it has stages and a sequence of methods that can be carried out sequentially and continuously, like a waterfall [8]. Each software development model has stages, including [9] (a) Investigation Stage: This stage was carried out to determine whether a problem has occurred or whether there is an opportunity for an information system to be developed; (b) Analysis Stage: this stage aims to find user and organizational needs and analyze existing conditions; (c) Design Stage: this stage aims to determine detailed specifications for information system components and information products that are in accordance with the results of the analysis stage; (d) Implementation Stage: this was the stage for obtaining or developing hardware and software (program coding), testing, training, and moving to a new system; (e) Maintenance stage: this stage is carried out when the information system has been operated. At this stage, process monitoring, evaluation, and improvements are carried out if necessary.

2.3. System Design Method

Decision Support Systems (DSS) are part of a computer-based information system that provides convenience in the process of problem solving and communication skills for problems with semi-structured conditions. Apart from that, decision support systems are created to provide information, make predictions, and make it easier for decision-makers to make better decisions [10]. The calculation method used in this research was the profile-matching method. Profile-matching mapping was done by determining the candidate ranking. To determine the ranking of candidates, profile matching needs to be carried out. The candidate ranking for this position was generated from the profile-matching process. In the profile matching method, the weighting was a definite value that is firm on a certain value because the existing values are members of a firm set. In a strict set, the membership of an element in the set is stated explicitly, whether the object is a member of the set or not, by using a characteristic function [11].

Profile Matching calculation stages [12] (a) Weighting, at this stage, the value of each aspect was determined using gap weights; (b) Grouping Core Factor and Secondary Factories, after determining the weight of the required gap criteria, each criterion was grouped into two groups, namely core factor and secondary factor. Core Factor uses the formula: NRC = $\frac{\sum NC}{\sum IC}$ ……(1) and secondary Factor used the formula: NRS = $\frac{\sum NS}{\sum IS}$ ……(2); (c) Calculation of the total value, the total value of each aspect used the formula: N = (X)%NCI + (X)%NSI ……(3); (d) Ranking, to get the ranking value, use the formula: Ranking = %N1 + %N2 ……(4).

3. Results and Discussion

3.1. Aspects of Criteria and Value Weight

In selecting Field Commanders, criteria were the main requirement in selecting and graduating participants, so each criterion had a value that was used as a benchmark in the decision support system. Each aspect was divided into criteria for a more in-depth and objective assessment. These aspects and assessment criteria were determined by the marching band coach. Table 1 is a table of aspects and criteria, along with the weights and types of factors that have been determined.

Table 1. Weighting of Aspect and Criteria Values

Stages	Aspects	Value Weights	Criteria	Ideal Values	Types
1	Aspects of Body Posture (A1)	30	Body Language (C1)	4	Core Factor
			Preparedness (C2)	3	Secondary Factor
			Marching Rules (C3)	4	Core Factor
2	Field Capability Aspects (A2)	40	Vocal (C4)	3	Core Factor
			General Knowledge about Marching Band (C5)	4	Core Factor
			Accuracy (C6)	4	Secondary Factor
3	Personality Aspects (A3)	30	Experience (C7)	4	Secondary Factor
			Attitude (C8)	4	Core Factor
			Attendance (C9)	4	Core Factor

3.2. Gap Mapping Calculation

After determining the weight value, ideal value, and type of criteria, the mapping calculation was then carried out. Mapping calculations were carried out by calculating the difference between the value of each criterion and the ideal value of each criterion. Then the calculation results were obtained, as shown in Table 2.

Table 2. Gap Mapping Calculation

Alternative	A1			A2			A3		
	C1	C2	C3	C4	C5	C6	C7	C8	C9
P1	4	4	4	4	4	4	4	4	3
P2	3	3	4	4	4	4	2	4	4
P3	4	4	4	4	4	4	2	4	4
P4	4	4	4	4	4	3	1	4	3
P5	4	4	4	4	4	3	2	4	4
P6	3	3	4	4	4	4	3	3	4
P7	3	3	4	4	4	3	1	4	4
P8	4	3	4	4	4	3	1	4	4
P9	3	3	4	4	4	4	1	4	4
P10	4	4	4	4	4	3	2	4	4
Ideal Values	**4**	**3**	**4**	**3**	**4**	**4**	**4**	**4**	**4**
P1	0	1	0	1	0	0	0	0	-1
P2	-1	0	0	1	0	0	-2	0	0
P3	0	1	0	1	0	0	-2	0	0
P4	0	1	0	1	0	-1	-3	0	-1
P5	0	1	0	1	0	-1	-2	0	0
P6	-1	0	0	1	0	0	-1	-1	0
P7	-1	0	0	1	0	-1	-3	0	0
P8	0	0	0	1	0	-1	-3	0	0
P9	-1	0	0	1	0	0	-3	0	0
P10	0	1	0	1	0	-1	-2	0	0

3.3. *Gap Value Weight*

After getting the gap value for each criterion value, a value weight was determined based on each value of each criterion. The difference value was then converted into a weight value. The value weighting was based on the values in Table 3. The weighting results can be seen in Table 4.

Table 3. Weighting Value

No	Difference	Value Weight	Explanation
1	0	5	There is no difference (competence as required)
2	1	4.5	1 level of excess competency
3	-1	4	1 level of deficiency competency
4	2	3.5	2 level of excess competency
5	-2	3	2 levels of deficiency competency
6	3	2.5	3 level of excess competency
7	-3	2	3 levels of deficiency competency
8	4	1.5	4 level of excess competency
9	-4	1	4 levels of deficiency competency

Table 4. Gap Value Weighting

Alternative	A1			A2			A3		
	C1	C2	C3	C4	C5	C6	C7	C8	C9
P1	0	1	0	1	0	0	0	0	-1
P2	-1	0	0	1	0	0	-2	0	0
P3	0	1	0	1	0	0	-2	0	0
P4	0	1	0	1	0	-1	-3	0	-1
P5	0	1	0	1	0	-1	-2	0	0
P6	-1	0	0	1	0	0	-1	-1	0
P7	-1	0	0	1	0	-1	-3	0	0
P8	0	0	0	1	0	-1	-3	0	0
P9	-1	0	0	1	0	0	-3	0	0
P10	0	1	0	1	0	-1	-2	0	0
Value Weight									
P1	5	4,5	5	4,5	5	5	5	5	4
P2	4	5	5	4,5	5	5	3	5	5
P3	5	4,5	5	4,5	5	5	3	5	5
P4	5	4,5	5	4,5	5	4	2	5	4
P5	5	4,5	5	4,5	5	4	3	5	5
P6	4	5	5	4,5	5	5	4	4	5
P7	4	5	5	4,5	5	4	2	5	5
P8	5	5	5	4,5	5	4	2	5	5
P9	4	5	5	4,5	5	5	2	5	5
P10	5	4,5	5	4,5	5	4	3	5	5

3.4. *Calculation of Core Factor and Secondary Factor*

The calculation of core factors and secondary factors was for the aspects of body posture, with core factors C1 and C3. Then the secondary factor from the aspect of body posture was C2. Then the values of the core factors and secondary factors were added up, referring to formulas (1) and (2), and the results are presented in Table 5 below.

Table 5. Core Factor and Secondary Factor Values for Aspects of Body Posture

Alternative	Body Posture				
	C1	C2	C3	NCF	NSF
P1	5	4,5	5	5	4.5
P2	4	5	5	4.5	5
P3	5	4,5	5	5	4.5
P4	5	4,5	5	5	4.5
P5	5	4,5	5	5	4.5
P6	4	5	5	4.5	5
P7	4	5	5	4.5	5
P8	5	5	5	5	5
P9	4	5	5	4.5	5
P10	5	4,5	5	5	4.5

The core factors for the field ability aspect were C4 and C5. Then the secondary factor from the field capability aspect was C6. Then the core factor and secondary factor values were added up according to the formula and the results are shown in Table 6 below.

Table 6. Core Factor and Secondary Factor Values for Field Ability Aspects

Alternative	Field Ability				
	C4	C5	C6	NCF	NSF
P1	4,5	5	5	4.75	5
P2	4,5	5	5	4.75	5
P3	4,5	5	5	4.75	5
P4	4,5	5	4	4.75	4
P5	4,5	5	4	4.75	4
P6	4,5	5	5	4.75	5
P7	4,5	5	4	4.75	4
P8	4,5	5	4	4.75	4
P9	4,5	5	5	4.75	5
P10	4,5	5	5	4.75	5

The core factors for personality aspects were C8 and C9. Then the secondary factor from the personality aspect was C7. Then the core factor and secondary factor values were added up according to the formula, and the results are shown in Table 7 below.

Table 7. Core Factor and Secondary Factor Values for Field Personality Aspects

Alternative	Personality				
	C7	C8	C9	NCF	NSF
P1	5	5	4	4.5	5
P2	3	5	5	5	3
P3	3	5	5	5	3
P4	2	5	4	4.5	2
P5	3	5	5	5	3
P6	4	4	5	4.5	4
P7	2	5	5	5	2
P8	2	5	5	5	2
P9	2	5	5	5	2
P10	3	5	5	5	3

3.5. Calculation of Total Value

After calculating the core factors and secondary factors for each aspect, the total score was then calculated based on the percentage of each core factor and secondary factor for each aspect, which could influence each participant's score. Calculations refer to formula (3). The calculation results can be seen in Tables 8, 9, and 10 below.

Table 8. Calculation Results of the Total Value of Body Posture Aspects

Alternative	Body Posture		
	NCF	NSF	Total Value
P1	5	4.5	(60% * 5)+(40% * 4.5) = 4.8
P2	4.5	5	(60% * 4.5)+(40% * 5) = 4.7
P3	5	4.5	(60% * 5)+(40% * 4.5) = 4.8
P4	5	4.5	(60% * 5)+(40% * 4.5) = 4.8
P5	5	4.5	(60% * 5)+(40% * 4.5) = 4.8
P6	4.5	5	(60% * 4.5)+(40% * 5) = 4.7
P7	4.5	5	(60% * 4.5)+(40% * 5) = 4.7
P8	5	5	(60% * 5)+(40% * 5) = 5
P9	4.5	5	(60% * 4.5)+(40% * 5) = 4.7
P10	5	4.5	(60% * 5)+(40% * 4.5) = 4.8

Table 9. Calculation Results of the Total Value of Field Ability Aspects

Alternative	Field Ability		
	NCF	NSF	Total Value
P1	4.75	5	(60% * 4.75)+(40% * 5) = 4.85
P2	4.75	5	(60% * 4.75)+(40% * 5) = 4.85
P3	4.75	5	(60% * 4.75)+(40% * 5) = 4.85
P4	4.75	4	(60% * 4.75)+(40% * 4) = 4.45
P5	4.75	4	(60% * 4.75)+(40% * 4) = 4.45
P6	4.75	5	(60% * 4.75)+(40% * 5) = 4.85
P7	4.75	4	(60% * 4.75)+(40% * 4) = 4.45
P8	4.75	4	(60% * 4.75)+(40% * 4) = 4.45
P9	4.75	5	(60% * 4.75)+(40% * 5) = 4.85
P10	4.75	4	(60% * 4.75)+(40% * 4) = 4.45

Table 10. Calculation Results of the Total Value of Body Posture Aspects

Alternative	Personality		
	NCF	NSF	Total Value
P1	4.5	5	(60% * 4.5)+(40% * 5) = 4.7
P2	5	3	(60% * 5)+(40% * 3) = 4.2
P3	5	3	(60% * 5)+(40% * 3) = 4.2
P4	4.5	2	(60% * 4.5)+(40% * 2) = 3.5
P5	5	3	(60% * 5)+(40% * 3) = 4.2
P6	4.5	4	(60% * 4.5)+(40% * 4) = 4.3
P7	5	2	(60% * 5)+(40% * 2) = 3.8
P8	5	2	(60% * 5)+(40% * 2) = 3.8
P9	5	2	(60% * 5)+(40% * 2) = 3.8
P10	5	3	(60% * 5)+(40% * 3) = 4.2

3.6. Ranking

The ranking calculation process is the final step in the total score calculation process. Calculations for ranking value refer to formula (4). To carry out the ranking, it was divided into 3 percentages of the total score; the percentage division was 30% for the total score from the body posture aspect, 40% for the field ability aspect, and 30% for the personality aspect. The results of the ranking values can be seen in Table 11 below.

Table 11. Ranking Value Results

Alternative	N1	N2	N3	Percentage			Percentage Amount
				30% * N1	40% * N2	30% * N3	
P1	4.8	4.85	4.7	1.44	1.94	1.41	4.79
P2	4.7	4.85	4.2	1.41	1.94	1.26	4.61
P3	4.8	4.85	4.2	1.44	1.94	1.26	4.64
P4	4.8	4.45	3.5	1.44	1.78	1.05	4.27
P5	4.8	4.45	4.2	1.44	1.78	1.26	4.48
P6	4.7	4.85	4.3	1.41	1.94	1.29	4.64
P7	4.7	4.45	3.8	1.41	1.78	1.14	4.33
P8	5	4.45	3.8	1.5	1.78	1.14	4.42
P9	4.7	4.85	3.8	1.41	1.94	1.14	4.49
P10	4.8	4.45	4.2	1.44	1.78	1.26	4.48

After carrying out calculations to get the final results for each selection participant using aspects of body posture, field ability, and personality, the names of the best selection participants were obtained. It can be shown in Table 12 below.

Table 12. Participants' Ranking Results

Rank	Alternative	Final Score
1	P1	4.79
2	P3	4.64
2	P6	4.64
4	P2	4.61
5	P9	4.49
6	P5	4.48
6	P10	4.48
8	P8	4.42
9	P7	4.33
10	P4	4.27

3.7. Modelling Design

To clarify the description of the system designed in this research, a use case diagram was used to explain the general description of the system. A use case diagram is a modeling tool to explain the behavior of the system to be created. By describing an interaction between one or more actors and the system, the use case was used to find out what functions exist in a system and who has the right to use these functions [13]. Figure 1 is a display for the use case diagram design.

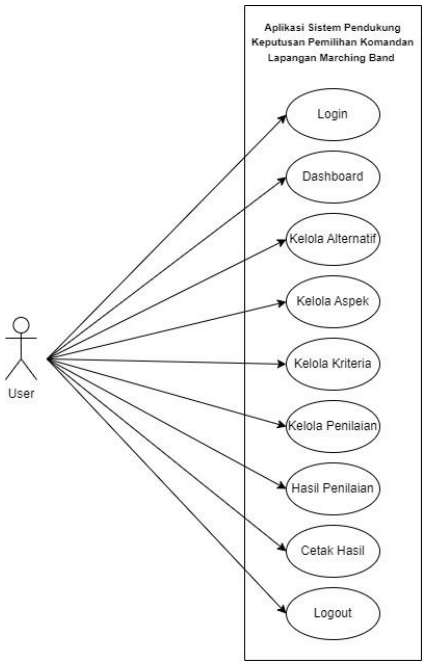

Figure 1. Design Use Case Diagram

In general, this system has one main user as the decision-holder. This user is filled by a marching band coach who wants to determine the best field commander based on the criteria given. Coaches can enter several sub-criteria provided by the system to determine the best marching band field commander. Trainers can access this system by logging in to it. To be able to log in, trainers need a username and password. After logging in, the coach can check the user profile via the homepage display, input selection criteria and sub-criteria data via the data input feature, input marching band member selection assessment data, and see the results of the criteria data analysis process inputted by the coach. The final result of the system is a recommendation for the best field commander candidate entered by the coach, whether the marching band members recommended are ideal or not for the coach.

The next modeling design is a diagram to describe the relationships between objects or entities and their attributes in database storage. The entity relationship diagram is depicted in Figure 2 below.

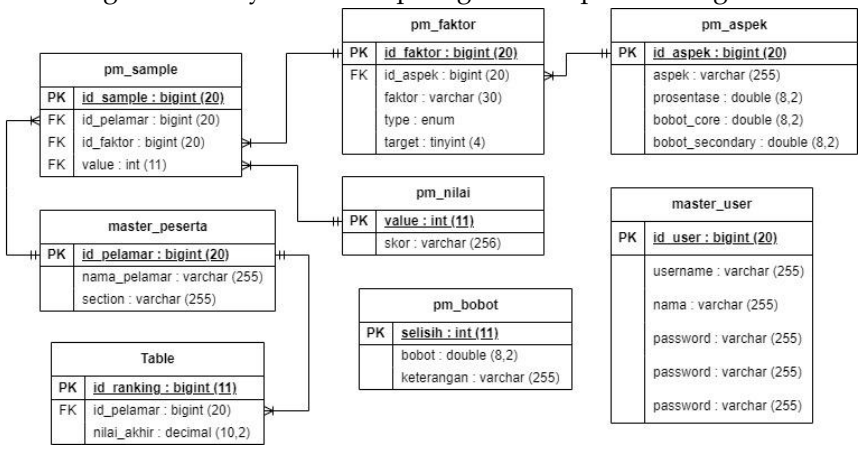

Figure 2. Entity Relationship Diagram

3.8. System Implementation

Implementation of the decision support system application interface for determining the best marching band field commander uses the PHP programming language. For a view of the implementation of the system interface, see Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8.

Figure 3. Login Page

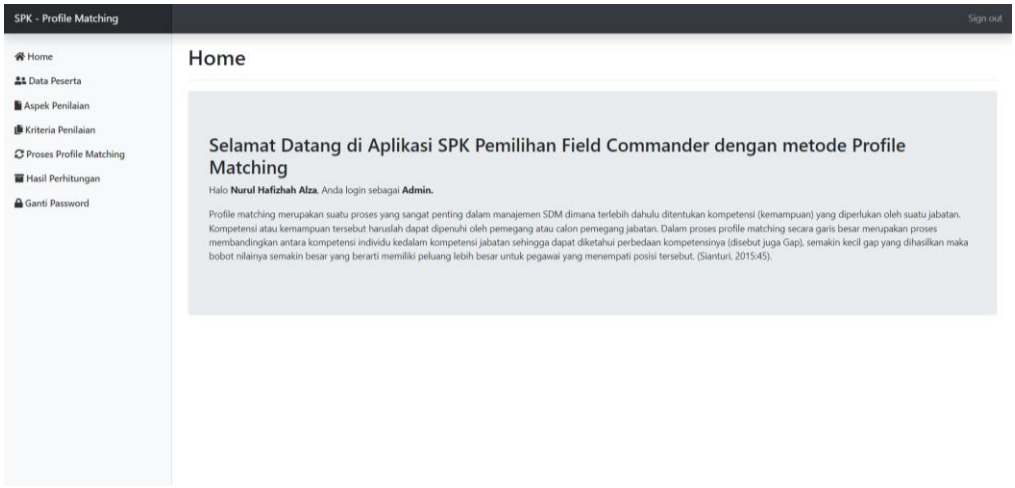

Figure 4. Home Page

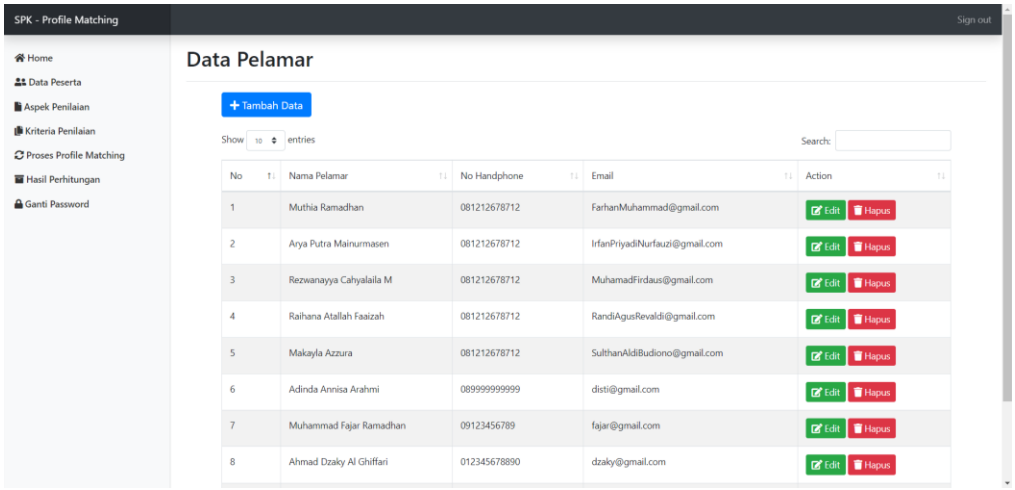

Figure 5. Participant Data Page

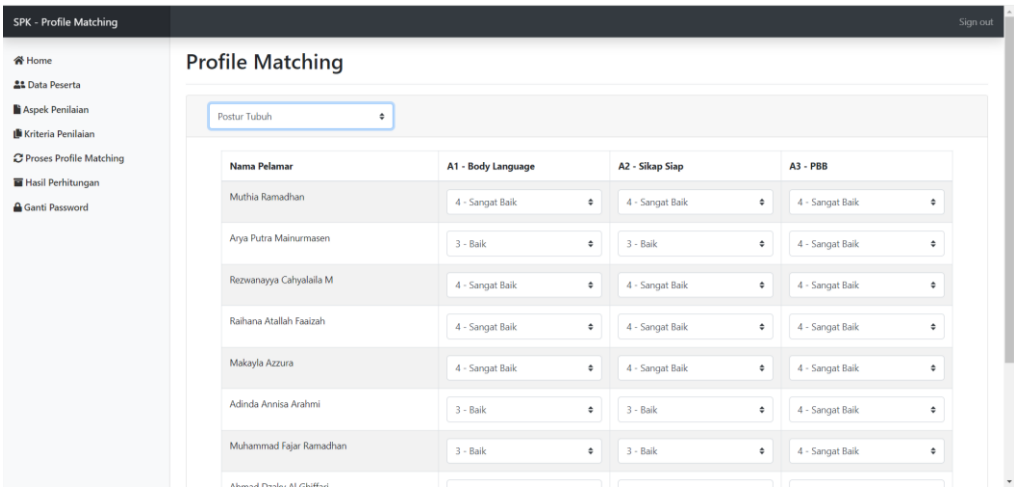

Figure 6. Participant Assessment Page

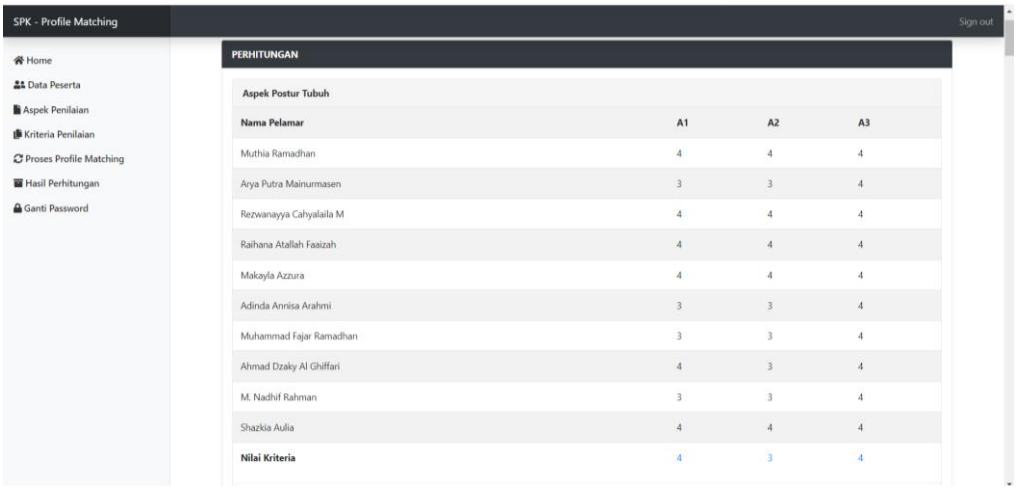

Figure 7. Value Calculation Page Uses Profile Matching

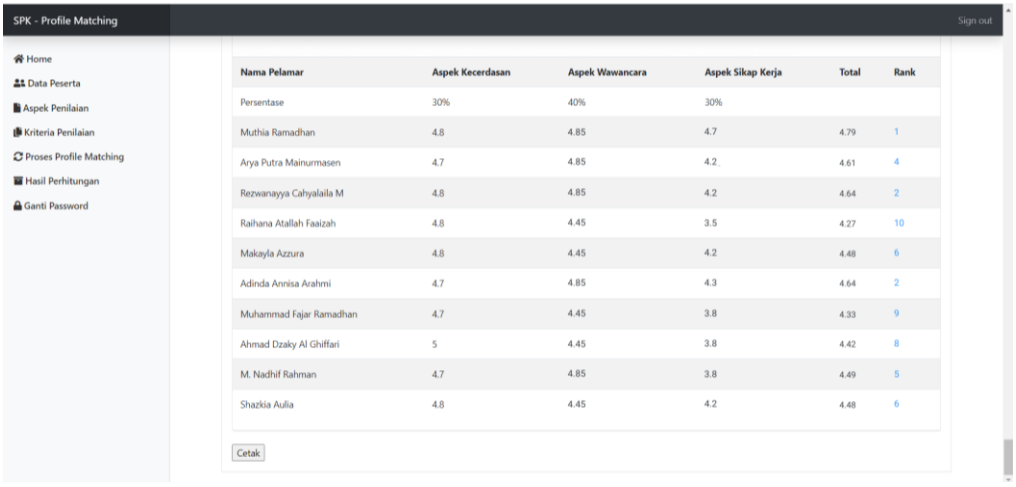

Figure 8. Alternative Ranking/Ranking Result Page

3.9. Construction

UAT testing was carried out by giving questionnaires to coaches and conducting interviews with marching band coaches. This testing was carried out to determine the user's response to the system that had been built, whether the system had overcome all the problems contained in the research background.

Testing was carried out by conducting questions and answers to the target user, in this case the marching band coach, to find out errors and discrepancies that were not previously discovered by the developer. Table 13 is the UAT testing result.

Table 13. UAT Testing Results

No	Functional	Scenario	Expected results	Conclusion
1	Login	Open login page	The application will display login form	Succeed
		Enter username and password on the login page	The application will display home page	Succeed
2	Home	The start page after user login.	Contains information related to profile matching, user name, and logout button.	Succeed
3	Manage Participant Data	View user data	The application displays a user data list page	Succeed
		Add user data	New user data is successfully added and the application displays the user data list page	Succeed
		Editing user data	The user data is successfully updated and the application displays the user data list page	Succeed
		Deleting user data	User data is successfully deleted and the application displays a user data list page	Succeed
4	Change Password	Change/renew password	Admin has successfully changed/renewed the password	Succeed
5	Manage Criteria	View criteria data	The application displays a page listing the criteria data	Succeed
		Add criteria data	The criteria data has been successfully added and the application displays the criteria data list page	Succeed
		Editing criteria data	The criteria data has been successfully edited and the application displays the criteria data list page	Succeed
		Delete criteria data	The criteria data is successfully deleted and the application displays the criteria data list page	Succeed
6	Manage Sub-Criteria	View sub-criteria data	The application displays a page listing sub-criteria data	Succeed
		Add sub-criteria data	The sub-criteria data has been successfully added and the application displays a page listing the sub-criteria data	Succeed
		Edit sub-criteria data	The sub-criteria data has been successfully edited and the application displays a page listing the sub-criteria data	Succeed
		Delete sub-criteria data	The sub-criteria data is successfully deleted and the application displays a page listing the sub-criteria data	Succeed
7	Manage Criteria Alternative Assessments	View alternative criteria data	The application displays a page listing alternative criteria data	Succeed
		Add alternative criteria data	The alternative criteria data has been successfully added and the application displays a page listing the alternative criteria data	Succeed
		Edit alternative criteria data	The alternative criteria data has been successfully edited and the application displays a page listing the alternative criteria data	Succeed
		Deleting alternative criteria data	The alternative criteria data has been successfully deleted and the application displays a page listing the alternative criteria data	Succeed
8	Profile Matching	View the results of the AHP	The application displays the results of the	Succeed

	Calculation Assessment Results	calculation assessment	AHP calculation assessment and displays the final assessment results.	
9	Print Assessment Results	Press the print button	Admin successfully printed the final assessment results	Succeed
10	Logout	Press the logout button	Admin successfully exited the application	Succeed

4. Conclusion

Based on the modeling process and data processing that has been carried out, it can be concluded that there are three aspects used in determining the marching band field commander, including body posture, field ability, and personality. The criteria used include body language, preparedness, PBB, vocals, general knowledge about marching bands, accuracy, experience, attitude, and presence. The development of a decision support system application is for selecting the best field commander using the PHP programming language, using a database to store processed data, and creating output in the form of rankings. With this decision support system built, the problem of determining the best marching band field commander can be resolved, helping marching bands determine the right field commander more objectively.

Based on the conclusions presented previously, several suggestions can be proposed to be taken into consideration in determining the best marching band field commander. In its implementation, system introduction and training are needed for marching band coaches as users are involved, to know and recognize the system that has been designed so that this system can be useful and used well and efficiently.

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