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Conference Paper

Fuzzy Analytical Hierarchy Process Method to Determining Most Valuable Player (MVP) in E-Sport

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ABSTRACT

E-Sport is a type of sports field that uses electronic devices such as consoles, handphones, and computers in its matches. Nowadays, this field has even been competed as a World Cup. One of the most popular games of 2024 with 100 million views on the Twitch app is Valorant. This study aims to apply the Fuzzy Analytical Hierarchy Process (F-AHP) method in determining the best players in one of the Valorant tournaments. A case study for the Valorant Champions Tour 2021: Stage 3 Master-Berlin is presented in this study. Where in 9 criteria according to coach of the Korean E-Sport team recommendation as an expert are assessed: (1) First Kill per Round, (2) Kills per Round, (3) First Death per Round, (4) Clutch Success, (5) Average Damage per Round, (6) Assist per Round, (7) Kill: Death, (8) Headshot, and (9) Round on each -each alternative player/competitor. The results of this study are the names of the best players who will be sorted based on the calculation of the total weight and also the alternative statistical values. The results showed that the player who managed to become the Most Valuable Player using F-AHP was TenZ with the highest score of 19.19. The checking in the form of accuracy is carried out by comparing the Fuzzy-AHP calculation and the expert weight value, which is 15%. The case study proves the feasibility and applicability of the proposed methodology for multiple criteria ranking problem. Future research may focus on creating a hierarchy of multilevel attributes to maximize the F-AHP algorithm.

Keywords: Valorant, fuzzy analytical hierarchy process, most valuable player, e-sport, alternative

Introduction

The determination of the Most Valuable Player (MVP) in sports especially e-sport represents a complex decision-making process that necessitates the evaluation of multiple criteria, including player performance, consistency, teamwork, leadership, and overall impact on the game. Traditional approaches to MVP selection frequently rely on subjective judgment, which can result in biased or inconsistent outcomes. To address these limitations, advanced multi-criteria decision-making (MCDM) methods, such as the Analytical Hierarchy Process (AHP), have been proposed to offer a more structured and systematic framework for the evaluation process. However, the standard AHP approach often encounters challenges in effectively managing the inherent uncertainty and vagueness associated with human judgments (ChatGPT, 2024). One of the games that is on the rise and is in demand is Valorant. Valorant is a game that has gone far to move to the third position of the most influential game in the world of E-sports. The number of watch hours of streamers using the Twitch application also increased by 100M hours of watching Valorant videos (Seck, 2020). Valorant is a First Person Shooter (FPS) game with 5 players per team. Valorant is

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published by Riot Games, a game developer from California, United States. This game requires players to think of attacking and defending strategies in order to win the game (Hakasviyanto, 2021). The winner in this game is not only the team that ranks first, but the player who has the best statistics will be the best player and will be appointed as Most Valuable Player (MVP) or what we know as the best player. Statistics are influenced by several criteria in a match, including kill, death, assist, first kill, and first death. The skills of each different agent do not affect the determination of MVP because these skills can be purchased by players or not, depending on the strategy of each team. Being the best player does not require subjective judgments (Chang, 1996) such as the most kills, the most fans, and so on. So, to overcome this, objective decision making is needed in selecting the best players, namely by judging from the overall statistics of the accumulated matches.

According to the previous study, AHP is a model used in making decisions describes the problem of several criteria into a hierarchy. AHP aims to solve complex problems caused by the uncertainty of precise and even non-existent statistical data. To overcome this, in this study the author will use another supporting model, namely the development of the AHP method, namely Fuzzy AHP. The fuzzy AHP method was researched to be superior to AHP in making unclear decisions (Julianto, 2020). According to the journal Comparison of Fuzzy AHP with AHP by Ahmad Faisol, the accuracy obtained is that F-AHP gets an accuracy rate of 84.62% and AHP gets an accuracy rate of only 23.08% in terms of the accuracy of the results of the property investment expert recommendation system. Another study showed that the fuzzy AHP method can be used in determining the right decision which includes data that has many criteria and respondents, it can be used in determining priority weights for each criterion. The AHP process also can be used as a tool in determining outstanding students by paying attention to quantitative data and the level of validity of the hierarchical consistency (Munthafa & Mubarok, 2017).

To mitigate these shortcomings, the present study proposes the application of the Fuzzy Analytical Hierarchy Process (F-AHP) method for MVP determination. The F-AHP method integrates the principles of fuzzy logic with the AHP framework, enabling more precise modeling of subjective assessments by incorporating degrees of preference rather than relying solely on exact numerical values. This hybrid approach is particularly advantageous in contexts where qualitative criteria are essential, and human judgment is a significant component of the decision-making process (ChatGPT, 2024). The primary objective of this study is to develop a comprehensive framework for the application of the F-AHP method in MVP selection in Valorant E-Sport. By leveraging the F-AHP's capacity to manage uncertainty and provide a more nuanced analysis of player performance, this approach has the potential to yield more reliable and equitable outcomes. The proposed method is anticipated to enhance the transparency and robustness of the MVP selection process, thereby serving as a valuable tool for coaches, analysts, and sports management professionals.

Material and Methods

Fuzzy logic

Fuzzy logic is logic that has true and false values called fuzzy. Professor Lofti A. Zaedah, a professor at the University of California, Berkeley, was the founder and marketer of the idea of processing mechanisms, now known to people as fuzzy logic. Fuzzy logic can be used in several management sciences such as control theory, decisions, etc (Fuzzy, 2020).

The advantage of fuzzy logic is that you can argue linguistically so no mathematical equations are needed in your design to control objects. An example of fuzzy logic in human life is the use of a washing machine by the Matsushita Electric Industrial Company produced by Japan in 1990. The fuzzy system automatically determines the synchronous centrifuge of the type and amount of dirty clothes to be washed. Optical sensors are used by the machine to send light into the water and calculate how far it reaches the other end. The dirtier, the darker the light.

Triangular Fuzzy Number (TFN)

Triangular Fuzzy Number is a fuzzy theory that is used to measure things related to the way humans judge subjectively. The conclusion of using the AHP and Fuzzy methods is that pairwise comparisons are described with a scale, namely the fuzzy scale. The triangular fuzzy number is denoted by M. The following are the membership function terms of the triangular fuzzy scale.

Table 1. Triangular fuzzy scale membership function

AHP's Level of Interest	Linguistics Association	Fuzzy Triangle Number (TFN)	Reciprocal
1.	Same comparison	(1,1,1)	(1,1,1)
2.	In the middle	(1/2,1,3/2)	(2/3,1,2)
3.	There are elements that are quite important from the others	(1,3/2,2)	(1/2,2/3,1)
4.	There are elements that are more important enough	(3/2,2,5/2)	(2/5,1/2,2/3)
5.	Many elements of strong importance	(2,5/2,3)	(1/3,2/5,1/2)
6.	in the middle	(5/2,3,7/2)	(2/7,1/3,2/5)
7.	There is an element whose level of importance is very strong from the others	(3,7/2,4)	(1/4,2/7,1/3)
8.	in the middle	(7/2,4,9/2)	(2/9,1/4,2/7)
9.	The existence of the strongest element of all elements	(4,9/2,9/2)	(2/9,2/9,1/4)

Analytical Hierarchy Process (AHP)

AHP was developed by Dr. Thomas L. Saaty at the Wharthon School of Business in the 1970s. This method is used to rank alternatives in a decision and can choose the best decision that can be an alternative if the person making the decision has many diverse criteria. In using AHP in making decisions, the method of ranking decision alternatives is based on whether or not each alternative is in accordance with the decision. According to Kadarsyah and Ali 1993, quoted by Munthafa and Mubarok (2017), there are several steps to solving the AHP, namely: Define the problem and determine the solution you want to use. Starting with the goal, create a hierarchical structure. Here is a picture of the hierarchical structure:

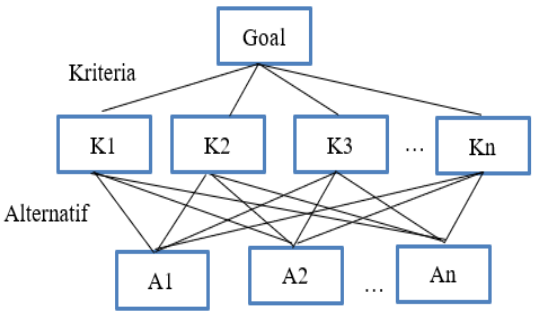

Figure 1. AHP hierarchy structure

Make a pairwise matrix comparison that describes the relative inclusion or influence of the elements in the objectives as well as the criteria in the previous level. Define the priority level of pairwise matrix comparisons.

Table 2. The priority level of pairwase matrix comparison

Intensity of Interest	Information
1	Each element has the same importance
3	One element is more important even if a little
5	One element is more important than the other elements
7	One element is more important than the other elements
9	One element is more important than the other elements
2,4,6,8	Judgment between two observations that are close to each other
Opposite	if activity a gets 1 number from activity b, then b has the opposite value when compared to a

Test the concentration and calculate the eigenvalues. If the values are consistent, the data collection is repeated. Repeat steps 3, 4, and 5 for all hierarchical levels. Calculate the eigenvectors of each pairwise comparison matrix, where is the weight of each element, in prioritizing starting at the lowest level of the hierarchy until the goal is achieved. The way to do the calculation is by adding the value of each related column to get a normalized matrix, then adding the value of each row and then dividing the value by the total number of elements to get the average value.

Fuzzy Analytical Hierarchy Process (F-AHP)

F-AHP is one of the decision-making methods which is a development from the traditional AHP. The F-AHP was studied better than the AHP in describing confusing decisions. The F-AHP method has a goal, namely to overcome the shortcomings of traditional AHP, namely AHP fails to provide precision in the evaluation of pairwise comparison matrices (A. H. Işık, 2015). In F-AHP, the value on the criteria is represented using TFN which is given the symbol (a,b,c) or (l,m,u). Here are the steps in completing the F-AHP according to D.-Y. Chang, 1996:

Building a hierarchical structure of the problem and making decisions, namely determining the value in the pairwise comparison matrix with the criteria using the Triangular Fuzzy Number scale.

Perform value calculations by Fuzzy synthesis (si), which is used in determining the area of an object, so that the extent analysis value M is obtained such as $M_{gi}^{1}, M_{gi}^{2}, M_{gi}^{3}, \ldots . M_{gi}^{n}, i =$ 1,2,3,4, … , n where M_{gi}^{j} with j = (1,2,3,4,...,n) is a triangular fuzzy number.

$$s_i = \sum_{j=i}^{m} M_{gi}^{j} \otimes \left[\sum_{i=1}^{n} \sum_{j=i}^{m} M_{gi}^{j} \right]^{-1} \qquad (1)$$

In finding M_{gi}^{1} it is necessary to calculate the fuzzy extent analysis by adding all the TFN numbers:

$$\sum_{j=i}^{m} M_{gi}^{j} = \left(\sum_{j=i}^{m} l_j, \sum_{j=i}^{m} m_j, \sum_{j=i}^{m} u_j, \right) \qquad (2)$$

Calculates the value of the defuzzification ordinate and calculates the comparison of the vector values of v3

$$V(M_2 \geq M_1) = sup[\min(\mu M_1(x), \mu M_2(y))] \qquad (3)$$

Normalize the fuzzy vector weights, serves to facilitate interpretation so that the vector weight values can be weighted non-fuzzy values and then calculating CR consistency.

Mean absolute percentage error

MAPE is a statistical calculation used by researchers in measuring the accuracy of a statistical model in determining the accuracy between manual calculation data and the system (Nabillah & Ranggadara, 2020). The formula for MAPE is as follows:

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{Ai - Fi}{Ai}\right| \text{ X } 100\% \qquad (4)$$

Results and Discussion

The test conducted by the author uses the Fuzzy Analytical Hierarchy Process (FAHP) method to determine the Most Valuable Player for the tournament of one of the E-Sport games, namely Valorant by taking data as many as 20 players from 78 total players, as well as weighting criteria by experts who are experts in their fields. The process found by the system will be compared with manual calculations so that it gets accuracy. The following are the results obtained from the Fuzzy AHP calculation. The calculation starts from AHP. when CR < 0.1 then the pairwise comparison matrix is changed to fuzzy ahp matrix. After that, the fuzzy synthesis value is searched. Find the ordinate value and get the weight of each criterion. the weight value is then multiplied by the value of each alternative.

Table 3. Alternative ranking results

	Alternative Ranking									
	K1	K2	K3	K4	K5	K6	K7	K8	K9	Total
A1	0,055	0,188	0,019	0,020	18,01	0,013	0	0	0	18,32
A2	0,052	0,192	0,023	0,036	18,66	0,015	0	0	0	18,98
A3	0,035	0,184	0,027	0,020	18,89	0,020	0	0	0	19,18
A4	0,038	0,188	0,019	0,017	17,68	0,017	0	0	0	17,96
A5	0,028	0,176	0,019	0,040	18,01	0,031	0	0	0	18,32
A6	0,040	0,1862	0,021	0,023	17,20	0,010	0	0	0	17,49
A7	0,031	0,1725	0,017	0	16,86	0,021	0	0	0	17,11
A8	0,052	0,160	0,029	0,017	16,51	0,020	0	0	0	16,79
A9	0,043	0,154	0,029	0,026	16,63	0,024	0	0	0	16,92
A10	0,057	0,168	0,033	0	15,91	0,011	0	0	0	16,19
A11	0,026	0,154	0,023	0,029	17,43	0,030	0	0	0	17,70
A12	0,050	0,149	0,027	0,01	17,23	0,017	0	0	0	17,50
A13	0,057	0,156	0,049	0	15,044	0,010	0	0	0	15,32
A14	0,026	0,162	0,019	0,029	16,24	0,025	0	0	0	16,51
A15	0,031	0,150	0,017	0,036	15,64	0,026	0	0	0	15,91
A16	0,016	0,156	0,009	0,018	16,14	0,039	0	0	0	16,38
A17	0,045	0,156	0,025	0,033	14,82	0,014	0	0	0	15,10
A18	0,043	0,154	0,025	0,029	13,93	0,013	0	0	0	14,20
A19	0,035	0,147	0,025	0,007	16,17	0,031	0	0	0	16,42
A20	0,011	0,147	0,011	0,03	16,79	0,034	0	0	0	17,03

Conclusion

The results of the calculations obtained by the Most Valuable Player decision-making system in the Valorant Champions Tour 2021: Stage 3 Master Berlin tournament using the Fuzzy Analytical Hierarchy Process (FAHP) is TenZ as the alternative which has the highest score in the competition, which is 19.19, followed by yay with a value of 19.19. 18.98, and heat with a value of 18.32. The validation results obtained by comparing manual calculations and also with the system are 99.91%. This shows that the system built is in accordance with the results of manual calculations. Accuracy results obtained by comparing the multiplication of weights by experts and alternatives with calculations obtained by Fuzzy AHP in determining the Most Valuable Player is 15%.

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