ORIGINAL ARTICLE

Feasibility Study on using MCDM for E-Voting

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ABSTRACT – An online voting system is an election system that manages the election process. This is a medium for the voters to cast their votes. It is also being used to calculate the votes collected from the voters to choose the representative for their own faculty. A typical voting system is based on a single attempt for each candidate being voted. The voting does not reflect the criteria implies to the characteristic of the candidate that going to be the student leader. To be a student leader, the student should fulfil the requirement such as good academic results, interpersonal skills with society, involving in activities of university and etc. Although the current voting system is able to maximize the participation of the voters, the voters may blindly vote the ballots casually due to they do not know the details of the candidates and the result is low quality and low public's trust in the selected candidate. In this study, the aim is to develop an interactive online voting system that have ranking feature with MCDM method which allow online voting system to collect high-quality results from the voters. The Multiple Criteria Decision Making (MCDM) method is used in the voting system while choosing the candidate. MCDM can let the voters make decision making or selecting the candidate based on the criteria that suit the position. The study starts with the literature study on implementing MCDM for a voting system. Then, a survey will be made to get the users' views on the with and without implementation of the MCDM method in an online voting system. The expected result of the study is to investigate the current implementation of MCDM as a tool for decision making, then identify the possibility of adopting MCDM for the online voting system while choosing the representative for faculty students' society. As a conclusion from the survey from the users' views, it shown that most of the users thinks that the system with the implementation with MCDM method is less time consuming and able to produce high quality result conpare to the current online voting system. Most of the respondents also stated that they are more preferring to use the online voting system with MCDM method in the future.

INTRODUCTION

An online voting system is an election system that store election data. It is important to have a safe voting platform to overcome problems during voters cast his/her vote [1]. The voting method that is usually used nowadays is a single-vote method, which is online single vote available and only one selected alternative. The online voting system process use by Universities now only let voters see the name and profile picture of the candidate that they can vote for. Each student may have a different personality such as family background, race, religion, educational background, characteristics, etc. All this information may not know by the voters. Hence, voters will just simply vote casually only based on the profile picture provided by the candidates. This show that the online voting system now actually is not perfect and effective enough. Although the online voting system can maximize the participation of the student to make their vote, however, if students don't know the details of the candidates and vote the ballots casually, it will lower the quality of the result from the online voting system.

The main objective of this paper is to apply the Multicriteria decision making (MCDM) method in the online voting system. MCDM is a very useful method that can make decision-making with more than one criterion [2]. The voters can make ranking in numerical analysis (1-5) based on different criteria. This method is less time-consuming to the voters and it will greatly increase the credibility of the candidate to be known by the voter. This show that voter will give some value based on the criteria. It will also allow the voters to get to know the candidate more.

The remainder of this paper is organized as follows: Section 2 briefly presents an overview of currently available voting systems and MCDM systems. Section 3 explains the proposed design for the online voting system with MCDM. Section 4 provides the expected outcomes of the online voting system. Section 5 concludes the paper.

RELATED WORK

This part provides a brief overview of a currently available voting system and MCDM systems. The system is being developed to use by the student to make a vote for the representative in the Universities. For this paper, three existing voting system and two existing MCDM system is chosen as the related works.

The voting system chosen to make the comparison is the UMP Voting System, UTM eUndiSiswa and Indian Voting machine. All the function of the voting system is to increase the voting efficiency by reducing time in casting and counting the votes. Although the existing voting system is able to generate a report and make data summation, however, the data collected is of low quality.

The MCDM system that was chosen to make the comparison include the IT Investment system and E-commerce Trust System. These two systems applied the MCDM method inside and the system was able to generate a report and make data summation with the benefit of high data accuracy using the comparison matrix.

The first existing voting system is the UMP E-voting system. UMP E-voting system has the features of a simple function that will generate the report and voting summation. The figure 1 below shows the interface design for the online voting system for UMP. It is the current online voting system that contain the general features to let the voters to cast their vote at specific location and the system with generate the report and the voting summation.
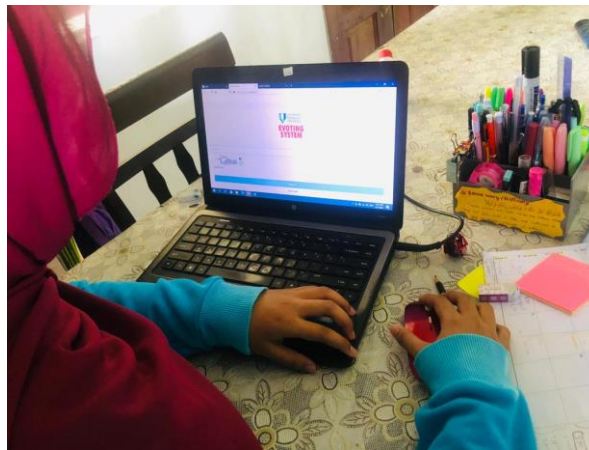

Figure 1: The interface design of an online voting system of UMP

The second existing voting system is Universiti Teknologi Malaysia (UTM) eUndiSiswa system. The UTM eUndiSiswa system has features the include candidate registration, voting security, generate reports and voting summation. It is a more safe system as the system only allows the universities students to login into the system with their id and password. The figure 2 below shows the interface design of the online voting system of UTM. The eUndiSiswa system also is one of the current online voting system that have the general features include let the voters of the Univesity to cast their vote at specific location and the system with generate report and the voting summation.
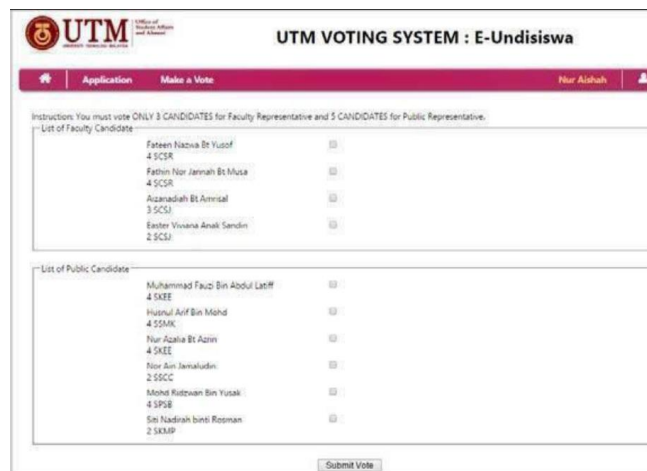

Figure 2: The interface design of an online voting system of UTM

The third existing voting system is the Indian Voting Machine. The Indian Voting Machine also called the Electronic Voting Machine ("EVM") has the feature of voting summation. It contains two logic devices that are connected with the

Control Unit Board. It contains a 5 meters cable to connect the connection between the Control Unit and Ballot Unit. The figure 3 below shows the Indian Voting Machine. The Indian Voting Machine is the most traditional voting method without the use of online. It can also generate report and voting summation. However, the data accuracy for this voting method is the worst in the three comparison of the tranditional voting system.

Figure 3: The Indian Voting Machine

The first existing MCDM system is the IT Investment system. The It Investment system is using the MCDM method namely AHP and TOPSIS with the aim that to provide a new methodology to evaluate the non-financial performance of firms. The figure 4 below shows the interface design of the IT Investment that using the MCDM method. The complex calcualtion is done by using the AHP and TOPSIS method. It contains several interfaces using the combo boxed with the input of the values, and several interface to calculate the weight of each of the criteria include the main criteria and the sub-criteria. This IT Investment system implement the MCDM method to analyses the relationship between the firm's non-financial performance and the IT investment. This system is developed using the Java, the interfaces of the system developed by using Java programing language is as shown in the Figure 4.
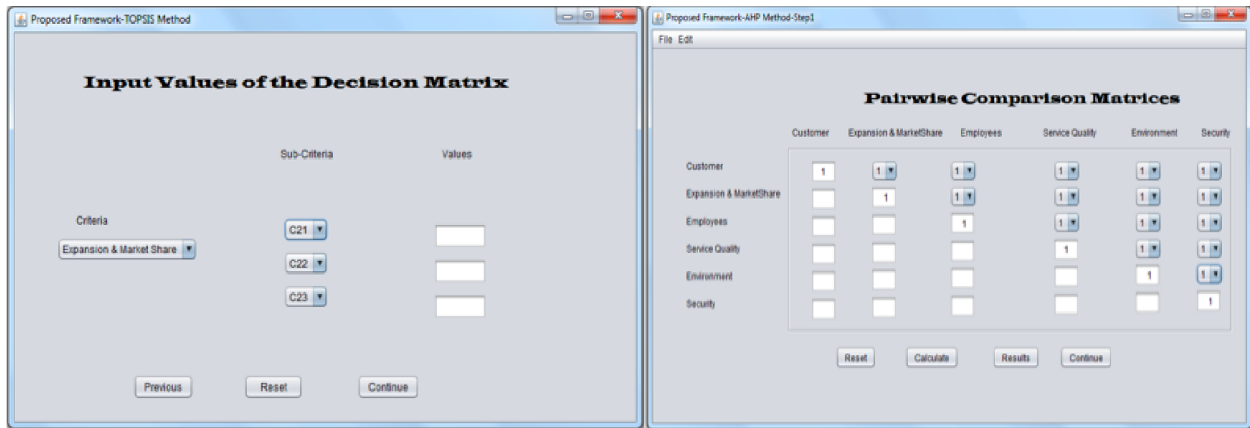

Figure 4: The interface design of IT Investment

The second existing MCDM system is E-commerce Trust System. The system uses the MCDM method which is the comparison matrix that includes Low Trust Level, Average Trust Level and High Trust Level. The figure 5 below shows the interface design of the EC-Trust Dashboard. The E-commerce Trust System contains the hierarchical modle that can assesed the multiple trust attributes. The subjective and objective trust and usability of the system can be test accurary using the MCDM method. This system also stated that can be used in the real-life due to it can overcome complex and highly dynamic existance problems. This system is using the ranking features based on the weight of each of the attributes for efficient decision making. This system also stated that can make efficient, reliable and valid decision for the e-commerce. It also able to minimize the development resources and cost.
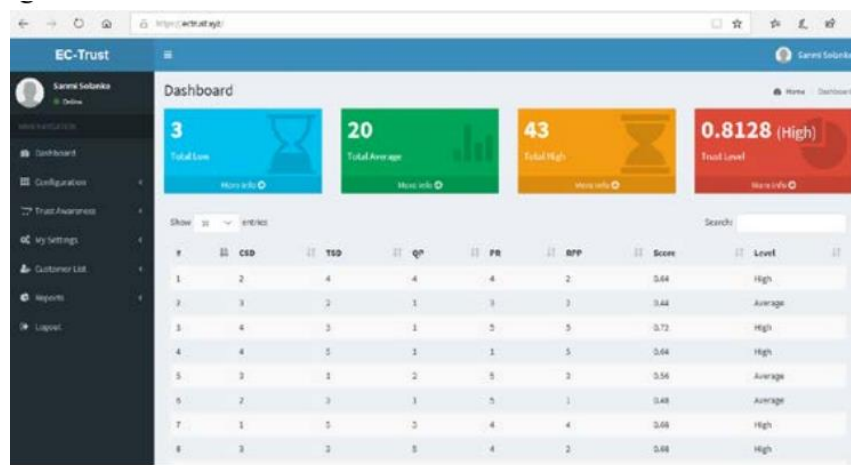
Figure 5: The interface design of EC-Trust Dashboard

The table 1 below shows the comparison of all the existing voting systems and MCDM systems. It shows that however, the online voting system can data summation but it is unable to provide high data accuracy. The IT Investment and E-commerce Trust System that using the MCDM could provide high data accuracy.

Table 1: Comparison Between the Existing System

System Criteria	UMP E-voting system	UTM eUndiSiswa	Indian Voting Machine	IT Investment	E-commerce Trust System
MCDM Method	X	X	X	/	/
Candidate Registration	X	/	X	X	X
Security	X	/	X	X	X
Generate Report	/	/	X	/	/
Data Summation	/	/	/	/	/
Data Accuracy	X	X	X	/	/

There are also many advantages and disadvantages between all these systems. The table 2 below shows the comparison of advantages and disadvantages each of the existing system that stated above. The table shows that the UMP E-voting System and UTM eUndiSiswa and Indian Voting machine be able to do the data summation automatically, however it contains the disadvantages of low accuracy and low-quality data. For the It Investment and E-commerce Trust system which using the MCDM method, it contains the advantages of produce high accuracy and high-quality data, though, it may consume a long time to collect the data compare to the system without the MCDM method.

Table 2 Advantages and Disadvantages Of Existing System

System	Advantages	Disadvantages
UMP E-voting system	-Automatically generate a report -Automatically data summation	-Low accuracy and quality data -Not Secure -Do not contain candidate registration function
UTM eUndiSiswa	-Candidate able to make registration -More Secure System -Automatically generate a report -Automatically data summation	-Low accuracy and quality data
Indian Voting Machine	-Automatically data summation	-System is not automated -Not Secure -Low accuracy and quality data
IT Investment	-High accuracy and quality data	-Long time consumed to collect data
E-commerce Trust System	-High accuracy and quality data	-Long time consumed to collect data

PROPOSED DESIGN FOR ONLINE VOTING SYSTEM WITH MCDM METHOD

Business Process Modelling

The business process modelling of the online voting system with the MCDM method is made to have a more clear view of the system. In the system, the admin should be able to add candidates to the system. After update all the candidates in the system, the system will display the details of the candidate. Voters are able login into the system to make voting. The only student with matric ID and password able to login into the system. The voters know how to make the voting in the criteria stated in the system. The system will be calculated automatically the result. The admin is able to view the report in the system. The voters can view the final result of the vote. The candidate with the highest rank will be selected. Figure 6 shows the figure of business process modelling of the online voting system that applied with the MCDM method.
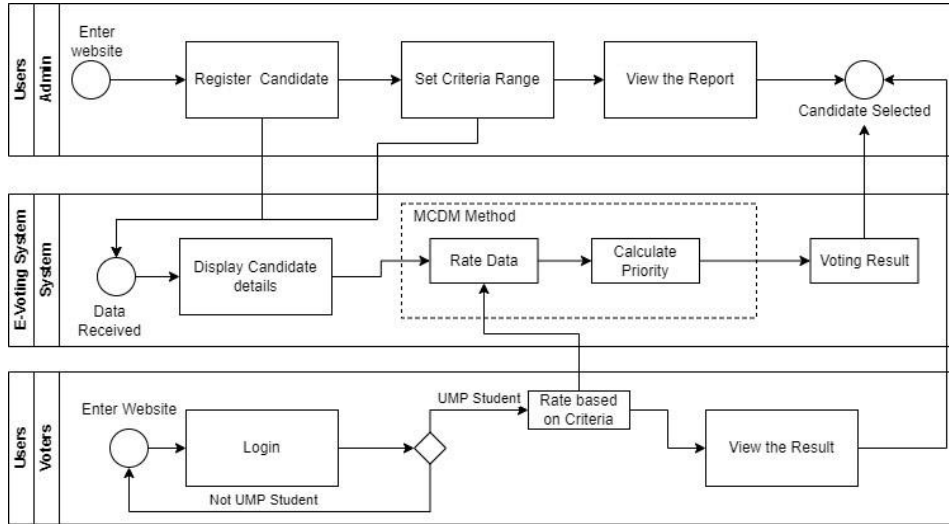

Figure 6 Business Process Modelling of Online Voting System with MCDM method

MCDM Method

Multi-criteria Decision Making (MCDM) method is a very useful decision-making tool that will make voters do the voting based on multiple criteria. As stated before, each candidate may come from different background and have different characteristics. This will make the voters make the true rate on each of the candidates and it can result in high-quality voting. The following is the sample calculation using MCDM method. For an example, the number of candidates is 5 and the number of criteria is 4 which include academic, kesukarelawan, community service and leadership.

Number of Candidate : 3
Number of Criteria: 4

Admin able to view the candidate criteria point using the UMP E-community system from the merit-demerit page. The figure 7 below shows the example page that where the admin able to view the criteria points from the UMP E-community system.

Figure 7 Student Merit Demerit Page from UMP E-community

The next step is the admin able to set the relative points for each criterion. Each of the criterion may have different points. The following is the table of the voting table with multiple criterions. The table shows the table of Criteria with the relative points.

Table 3 Sample table of Criteria with relative points

Criteria	Rank				
	5	4	3	2	1
Academic(C1)	0-8	9-10	11-17	24-25	32-40
Kesukarelawan(C2)	0-60	61-120	121-180	181-240	241-300
Community Service(C3)	0-60	61-120	121-180	181-240	241-300
Leadership(C4)	0-60	61-120	121-180	181-240	241-300

The system will compare the criteria data of each candidate to get the current rank based on criteria of the candidate. The table (Table 5) below show the example result after comparison criteria data of each candidate (Table 4) and the table of criteria with relative points (Table 3).

Table 4 Example Criteria Data input by Admin from UMP E-community

Candidate	Criteria Data (From UMP E-Community)			
	C1	C2	C3	C4
1	0	50	110	103
2	15	199	122	110
3	39	235	299	190

Table 5 Comparison Result Between Table 3 and Table 4

Candidate	Rank			
1	5	5	4	4
2	3	2	3	4
3	1	2	1	2

The system will find the highest rank each candidate as nominator and calculate point for each criterion based on candidate using the function below. Table below show the sample calculation of after divided by the nominator.
Function:

$$nominator = highest\ rank\ of\ each\ candidate \qquad \text{Eq. (1)}$$
$$Points = rank/norminator \qquad \text{Eq. (2)}$$

Table 6 Sample Calcuation to get the points of each criterion based on Candidate

Candidate	Rank			
1	5	5	4	4
2	3	2	3	4
3	1	2	1	2
Nominator (The highest rank)	5	5	4	4
	Points after Divided by Nominator			
1	1	1	1	1
2	0.6	0.4	0.75	1
3	0.2	0.4	0.25	0.5

The voters able to rank based on criteria. The voters only able to view the criteria but not the candidate details. This will avoid voters from blindly vote candidate in the voting system. Voters rate the criteria using stars (maximum 5 star, minimum 1 star). Voters will rank the criteria based on their thinking about which criteria is more important to hold a position. The higher the star the voter rank, the more important their thinking about that criterion as an ability to hold a position. The table below show the sample data get from the voters.

Table 7 The Example Ranking Data Collected from Voters

Voter	Total of Star of Each Criterion				Total
	C1	C2	C3	C4	
1	2	4	3	2	11
2	4	5	2	3	14
3	5	5	4	1	15

The system will calculate the priority. The star insert by the voters also can stated as the confident of vote on that candidate based on that criterion. The system will calculate the star sum and rank the highest candidates in the system. The following is the function and sample calculation in MCDM method.

Function:

$$Sum = C_1 + C_2 + \cdots + C_n \qquad \text{Eq. (3)}$$
$$T = \big((C \div sum) * 100\big) * Points \qquad \text{Eq. (4)}$$

The table below shows the sample calcualtion summary data using the MCDM method.

Table 8 The Sample Calculation of MCDM

Voter	Criterion	Academic (C_1)	Kesukarelawan (C_2)	Community Service (C_3)	Leadership (C_4)	Total	Rank
1	Candidate-1	18.18	36.37	27.28	18.18	100.00	1
	Candidate-2	10.91	14.55	20.45	18.18	64.09	2
	Candidate-3	3.64	14.55	6.82	9.09	34.1	3
2	Candidate-1	28.57	35.71	14.29	21.43	100	1
	Candidate-2	17.14	14.29	10.71	21.43	63.57	2
	Candidate-3	5.71	14.29	3.57	10.71	34.28	3
3	Candidate-1	33.33	33.33	26.67	6.67	100	1
	Candidate-2	20.00	13.33	20.00	6.67	60	2
	Candidate-3	6.67	13.33	6.67	3.33	30	3

The system will do the counter process by using the static point based on each rank that set in the system. The static point is as shown in below. The table below also show the counter that will be counted automatically by the system.

Static Point for each rank:

$$Rank\ 1 = 5\ points;$$
$$Rank\ 2 = 4\ points;$$
$$Rank\ 3 = 3\ points;$$
$$Rank\ 4 = 2\ points;$$
$$Rank\ 5 = 1\ points;$$
$$Rank\ 0 = 0\ points;$$

Table 9 The Sample Final Result Calculated by the System.

Candidate	Result
Candidate-1	15
Candidate-2	12
Candidate-3	9

From the table above show that, the candidate one will be selected to hold a higher position in faculty due to candidate 1 have high ability on skill on each criterion. The other candidate also able to hold second higher or lower position at the faculty based on the result calculated automatically from the system.

RESULT

The new voting system with MCDM is expected to be less time-consuming compare to the current voting method that implements a single attempt currently using the google form. Usability test is used to test the usability of the system. There is thirty-two people was chosen to test the usability of the system. The google form collect the personal view of respondent about current online voting system and online voting system with MCDM method.The figure 8 show the result of 93.8% of the respondent think that the online voting system with MCDM will be less time consuming.

By using system with MCDM method, do you think that this system will be less time consuming compare to current online voting system?
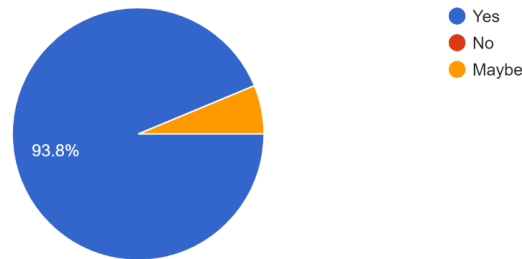32 responses

● Yes
● No
● Maybe

93.8%

Figure 8 Result About the System with MCDM is less time-consuming

The figure 9 below show the result collected from thirty-two respondents about which of the system the respondents more prefer to use in the future.

Based on your understand, which of the system you are more prefer to use? Please rate the system
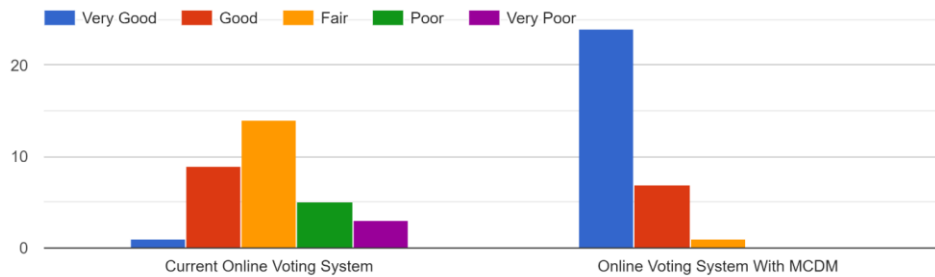

■ Very Good   ■ Good   ■ Fair   ■ Poor   ■ Very Poor

Figure 9 Compariosn Usability Between Current Online Voting System and Online Voting System with MCDM method

FUTURE WORK

There are some features of this system can be improved in the future work of the system. Below is the list that recommended to be implemented into the system as to improve the Online Voting System in the future.

Table 10 Future Work

No	Feature	Description
1	Encrypted the password in the database	This feature is very important to protect all the users' details, the password in database should be encrypted to avoid the hacker to steal the personal information of the users.
2	Email notification	Email notifications are very useful for the users to get any new notice from the system.

CONCLUSION

This paper purpose a sucure online voting system that contains the multiple criteria decisions making(MCDM) approach. The main objective of . The main objective of this proposal is to investigate whether the online voting system is not time-consuming rather than the current voting system. From the result of the survey form, it shown that the online voting system with MCDM method is less timeconsuming and able to produce high quality result compared to the current online voting system. Most of the respondents from the survey also stated that they are more preferring to use the online voting system with MCDM method in the future. The online voting system that contains MCDM approach can ensure that voters is not blindly vote without knowing the candidate. The system is secure due to only UMP student with matric number and password able do the online voting. This system is preferable due to the voters able to vote based on their belief on the criteria that should have for a candidate to hold a position in an organization. The system will calculate the result by collecting ranking result from voters and lastly provide a high-quality result. By using the MCDM approach, all the calculation will count by the system automatically and users can perform the action easily by staying at hostel or home to prevent the spread of COVID-19. The combination of the above features able to increase the public's trust on the online voting system able to choose the best candidate by increasing the quality of vote based on multiple criteria.

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