SMVS: A Web-based Application for Graphical Visualization of Malay Text Corpus

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***Abstract*— Information visualization is an interesting field nowadays. A good information visualization ensures distraction of misleading information is not included in the visualization. Many studies have been conducted on the Quranic corpus. The advancement technology coupled with modern approach of the computer technology can support the learners to understand Qur'an easily. Smart Malay Visualization System (SMVS) is a Python Flask framework web application which help users efficiently to produce the most basic data visualization from a big data. This web application displayed information from the state-of-the-art corpus which is identified through text. Agile development has been adapted to prepare this web application. Six phases of the methodology have been implemented in this study which are requirements, analysis, planning, design, implementation, testing, and deployment. Natural Language Processing approach has been used to visualize the data. Twenty most informative word from each verse has been visualized using Frequency Distribution and has been embedded to the web application. This work focuses on the Malay translation of the Qur'an corpus.**

Keywords*— *Big data, data visualization, knowledge representation, Qur'an knowledge, natural language processing

I. Introduction

Information visualization is the process of representing data in a visual and meaningful way in order to make a better understanding. Visualising aspects of corpus data can be useful for discovery as well as for communicating results [1]. Meanwhile, data visualization is a similar study which focused on the presentation of data in a pictorial or graphical format. As stated in [2], the volumes of digital collections continue to grow and the traditional methods become increasingly ineffective, leading to a transition on the use of graphs and maps to interpret textual data. Visualizations are useful to ease understanding of large amounts of data quickly.

The views of information and visualization deduce two important aspects: (1) information visualization is used to discover new insights and knowledge from abstract data through graphical, and (2) information visualization can be considered a representation of data that amplifies cognition [3]. Importantly, right visualization types must be chosen to ensure distract or mislead information are eliminated.

In addition, the major problem with data visualization is confusion of data [4]. Study in [4] stated that graphical visualization with no accompanying text and lack of clear overall logic may confuse the viewers. Furthermore, many visualizations may have implicit meaning which adds to the problem of not explained thoroughly and may be misinterpreted. Some sentences are fundamentally difficult to understand which lead to visualizations that depict many complex relationships and are not optimally represented.

Meanwhile, Information extraction is the process of extracting specific (pre-specified) information from textual sources. It remains a fundamental challenge for any system that works with structured data [5]. The process involves transforming an unstructured text or a collection of texts into sets of facts. The good information extraction solutions are a combination of automated methods and human processing. Tokenization process is used in the extraction information before representing the visualize data.

In computational linguistic, text corpus is a large and structured sets of texts within a specific language territory [1]. Researchers used state-of-the-art corpus in various type of subject such as speech recognition and machine translation [6-7].

Many studies have been on Qur'an corpus such as studies in [8-10]. The understanding of the Quranic knowledge does not only require appropriate teachers, computer technology can also support the learners to understand Qur'an easily, especially in the web and mobile-based environment [11]. The Qur'an consists of 30 divisions (Juz), 114 chapters (Surah), and 6236 numbered verses (ayat). Many efforts to create online information systems for the Qur'an knowledge has been implemented such as work by [8-11]. In this study, the focus is on the final division, or known as Juz Amma.

Three objectives are developed for this study, which are (i) To gather requirements for Malay data visualization system which can be operate online, (ii) To built-up web application for the Malay data visualization, and (iii) To evaluate web application for the Malay data visualization system.

II. Related Study

In recent years, data visualization for the big data studies were popular to support literary scholars and experts from other domains. Visualization is the process of transforming data, information, and knowledge into visual forms of which we could have insights [12].

Visualization is not an end but a means toward an end, which is understanding. Basically, one does not speak about

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visualizing a diagram but visualizing a concept or problem. To visualize a diagram means simply to form a mental image of the diagram, but to visualize a problem to understand the problem in terms of a diagram or visual image [13]. A graph visualization for Text Variant Graphs model which highlight in a data structure that represent various editions of a text is proposed by [14].

Information extraction methods can be used by employing approaches such as Natural Language Processing (NLP), Text Mining and Data Mining. In this study, the NLP approach has been used to extract valuable information. Natural language processing (NLP) method extracts structure from textual representations of information. As in [15] the interface can be used to generate visual interpretations of the semantic content of a given natural language that can be then visualized either as a static scene or a dynamic animation. Many studies have used the NLP approach such as studies in summarization [16], semantic understanding [17], name entity identification [18-19], and discourse [20]. By using all these body of knowledge, creating useful visual representation from the textual information sources is a current new direction.

III. Methodology

The study was conducted following agile methodology. Agile development methodology is used in order to implement this web application since it has iteration. This methodology consists of requirements analysis, planning, design, implementation, testing, and deployment. In this project, agile model is used as the methodology of the SMVS. In this Agile Model, prior planning, the requirement for the system is identified. Then, the model is developed and tested, and the design is ready for coding and testing. This will be based on user requirement. The flow of the phases is illustrated in Fig. 1.

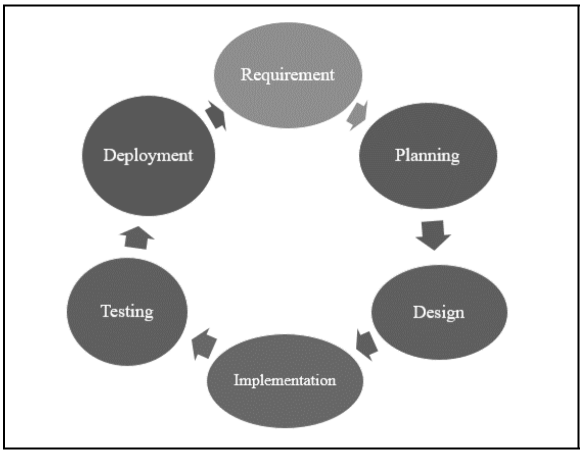


Fig. 1. Agile development methodology.

There are several techniques that can be used to analyze the user **requirements** such as case diagram that shows the users that had been assigned to the requirements. Then, the sequence diagram is derived as user manual because it explains the function of the systems based on user requirements. Sequence diagram is a design based on the use case specification. The **planning** of the system has to be made when all the requirement are already identified. At this phase, system will be planned and visual will be identified for the data visualization system. This system will display information from a big data into data visualization.

Next, the **design** phase is about the design of the system before proceeding to low-fidelity based on the user requirements. Class diagram will be used to help in identifying and understanding the requirements of the problem domain and to identify its components.

The installation is needed in the **implementation** stage. Class diagram has been used to convert a model into code in this phase. Then, the developer would install the right software in order to develop the system. There are several software can be used to develop high fidelity application such as Python, Flask framework, Dreamweaver, and Notepad.

In the development process, **testing** is an important phase. This phase ensures that the software and hardware function well closely to the target performance. Test case should include ID, action, expected result, actual result, and to decide the functionality of the test. **Deployment** focuses on production and technical support. It is the stage where the system has been developed and ready to be released to the user. The user can use and give feedback on the developed system. Since developer uses agile development, it has iteration where it will start from the first stage of next iteration if any changes or updates occur.

IV. Design and Development of SMVS

This section describes the design and development of a web based for creating visualization system. The section is divided into two sub-sections; (1) the requirements of the web based for creating visualization system, and (2) the prototype development of SMVS; a web-based application developed to demonstrate the gathered requirements.

Two ways were employed to gather the requirement process such as (1) to select the respondents based on the suitability of the respondents, and provide the questionnaire through Google form link, while the respondents answer all questionnaires given, and (2) from the internet, systems that are related to the visualization system are analysed. with the questionnaire also included open-ended questions on the features of the web-based application. The questionnaire consisted of four sections, namely, usefulness, ease of use, satisfaction, and security.

The other requirement for gathering data was through search engine platforms. The article was being search at Google search engine platform by using many key words such as, “visualization”, “Malay visualization system”, “data visualization”, “verse Qur’an” and etc. Other than that, related article of system was searched in relevant websites. All the findings were analyzed and ideas were formed to solve the problem. Then, ideas for this system requirement such as register, login, manage content, manage usability experience design and manage visualization process were also deduced. Table I shows the requirement involve in SMVS.

TABLE I. LIST OF REQUIREMENTS FOR SMVS

ID	Requirement Description	Priority
1	***Account Registration***	
1.1	Users must register their details such as username, email and password	M
	The system shall notify if the registration form is incomplete	D
2	***Login***	
2.1	The user that have registered, must login using email and password	M
2.2	The user that forgot their password, they can retrieve password using email	D
2.3	Admin must verify the validity of user's email and password	M
3	***Manage Content***	
3.1	Users (students and lecturer) can add data or information	M
3.2	Users (students and lecturer) can delete data or information	D
3.3	Users (students and lecturer) can update the data or information	D
3.4	Users (students and lecturer) can search the types of visual	D
3.5	Users (students and lecturer) can click cancel before the system translate into visual	D
3.6	Users (students and lecturer) will get the result when admin confirms for visualize the data	M
4	***Manage Usability Experience Design***	
4.1	Admin can create contact us information	M
4.2	Admin can read contact us information	M
4.3	Admin can update contact us information	O
4.4	Admin can delete contact us information	O
4.4	The system will display contact us information	O
5	***Manage Visualization Process***	
5.1	Admin can add the data or information	M
5.2	Users (students and lecturer) can view the result of the information efficiently	M
6	***Social Media Marketing***	
6.1	Admin can create embed to social media icon	O
6.2	Admin can read embed to social media icon	O
6.3	Admin can update embed to social media icon	O
6.4	Admin can delete embed to social media icon	O
6.5	Users (students and lecturer) can click social media icon for sharing	M
7	***Logout***	
7.1	Admin and users shall be able to logout	M

The requirements presented in Table I were translated into the computer system functionality. The next process is visualizing and modelling the requirements using the appropriate modelling method and tools. In this work, the Unified Modelling Language (UML) was used to visualize and model the requirements. The models used in this work are two behavioural diagrams namely use case and sequence diagram, and a class diagram that represents the structural components of the system. The diagrams were drawn using StarUML and Violet. Seven major use cases are register, login, manage content, manage usability experience design, manage visualization process, social media marketing and logout.

Visualization process starts when the web application is started. The text corpora are fed into the linguistic processing pipeline that applies a tokenizer, a sentence splitter and stop-word. After tokenization and sentence splitting, the pipeline identifies all token that occur in more than one of the source texts. After pre-processing, identification of the most informative about the text corpus are made. The frequency distribution technique has been used in this study which informs the frequency of each vocabulary item in the text. The distribution information informs how the total number of word tokens in the text are distributed across the vocabulary items. In this study, Natural Language Toolkit (NLTK) using Python 2.0 provides built in support for the *FreqDist* function that has been embed to the web application. Based on the twenty most informative occurrence, an interactive visualization shows the cumulative frequency plot of each verses in the web application. Fig. 2 shows the flowchart for visualize process of SMVS.

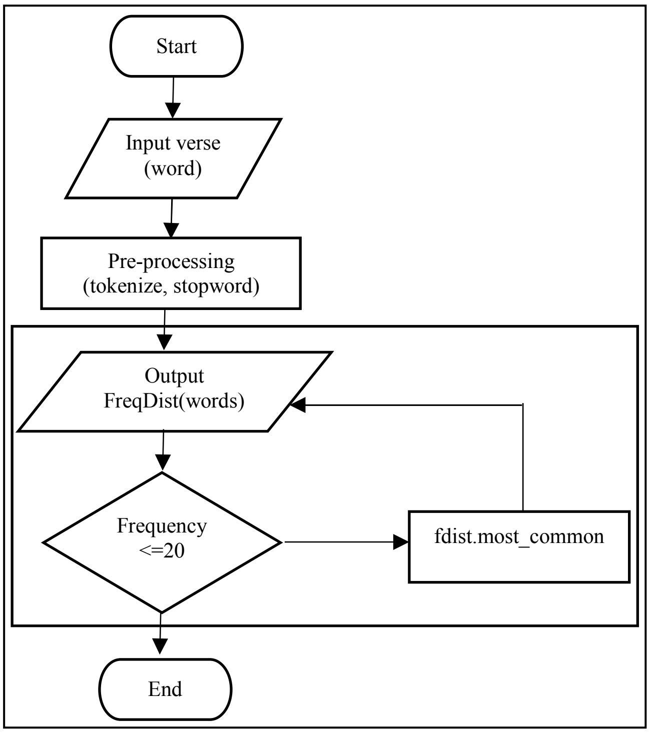
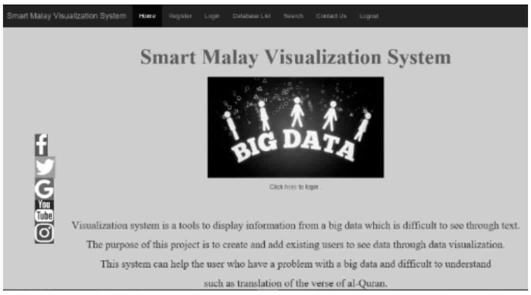


Fig. 2. The flowchart for visualize process of SMVS.

V. THE SMVS PROTOTYPE DEVELOPMENT

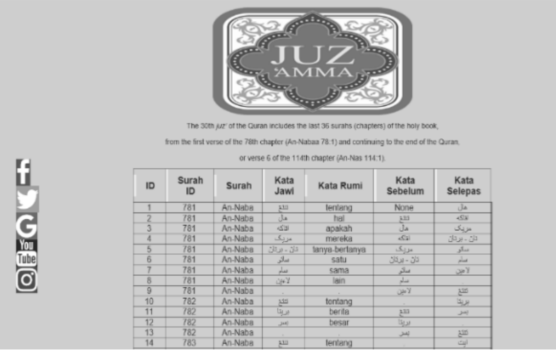
A prototype of the web application for creating visualization system named SMVS was developed. It represents the requirements explained in the previous subsections. This system used DB SQLite as a platform to save the data like authentication and database for storage. Here, Fig. 3-6 are screenshot and selected from SMVS.



Smart Malay Visualization System

Visualization system is a tools to display information from a big data which is difficult to see through text. The purpose of this project is to create and add existing users to see data through data visualization. This system can help the user who have a problem with a big data and difficult to understand such as translation of the verse of al-Quran.

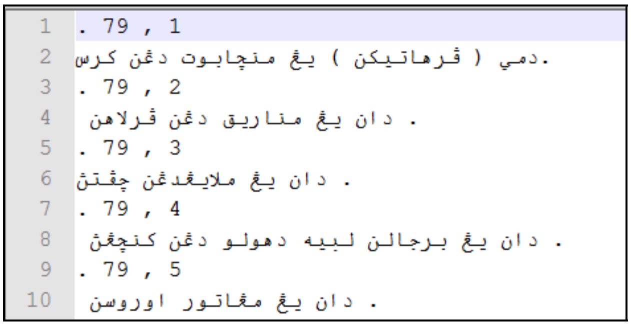
Fig. 3. Main page.



The 30th *juz'* of the Quran includes the last 36 surahs (chapters) of the holy book,
from the first verse of the 78th chapter (An-Nabaa 78:1) and continuing to the end of the Quran,
or verse 6 of the 114th chapter (An-Nas 114:1).

ID	Surah ID	Surah	Kata Jawi	Kata Rumi	Kata Sebelum	Kata Selepas
1	781	An-Naba	تنتڠ	tentang	None	هل
2	781	An-Naba	هل	hal	تنتڠ	اڤاکه
3	781	An-Naba	اڤاکه	apakah	هل	مريک
4	781	An-Naba	مريک	mereka	اڤاکه	تاڽ - برتاڽ
5	781	An-Naba	تاڽ - برتاڽ	tanya-bertanya	مريک	ساتو
6	781	An-Naba	ساتو	satu	تاڽ - برتاڽ	سام
7	781	An-Naba	سام	sama	ساتو	لاٴين
8	781	An-Naba	لاٴين	lain	سام	.
9	781	An-Naba	.	.	لاٴين	تنتڠ
10	782	An-Naba	تنتڠ	tentang	.	بريتا
11	782	An-Naba	بريتا	berita	تنتڠ	بسر
12	782	An-Naba	بسر	besar	بريتا	.
13	782	An-Naba	.	.	بسر	تنتڠ
14	783	An-Naba	تنتڠ	tentang	.	ايت

Fig. 4. Data list page.



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. 79 , 1
.دمي ( ڤرهاتيکن ) يڠ منچابوت دڠن کرس
. 79 , 2
 . دان يڠ مناريق دڠن ڤرلاهن
. 79 , 3
. دان يڠ ملايڠدڠن چڤتڽ
. 79 , 4
 . دان يڠ برجالن لبيه دهولو دڠن کنچڠڽ
. 79 , 5
 . دان يڠ مڠاتور اوروسن
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Fig. 5. The example of the raw text.

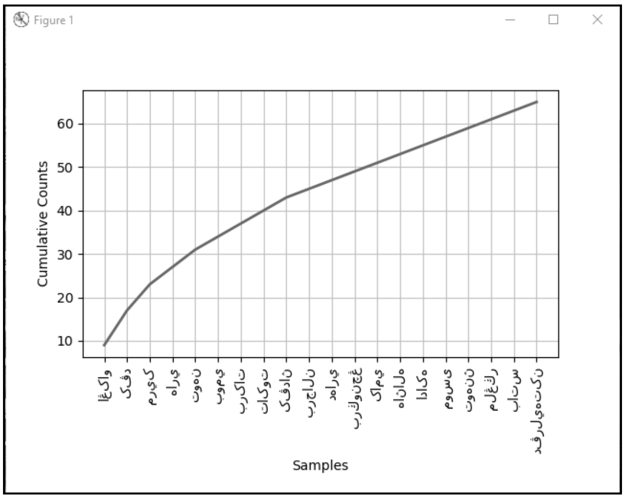

Fig. 6. Graphical visualization result.

V. Evaluation of SMVS

A usability evaluation was conducted on 30 respondents, consisting students and lecturers in Universiti Utara Malaysia (UUM). The respondents were approached randomly among students in UUM. The instrument that have been used was a questionnaire in prepared in Google form.

The post-task questionnaire was adapted for 22 questions, which consists in two sections. Section A asked the respondents' about demographic information while Section B asked for the respondents to evaluate the SMVS by rating their agreement with a 5-point Likert scale, from strongly disagreed to strongly agreed. The respondents performed the following step-by-step procedure for the evaluation: (1) The respondent sits with a computer connected to the Internet, 2) the respondent reads the information, 3) the respondent interacts with the system, 5) the respondent answers the post-task questionnaire. Appendix A shows all the components.

A. The Respondents' Demographic Information

Analysis of the respondents' demographic information revealed that 100% of the respondents were students, 100% of them aged between 21 and 25, and 25. 96.7% of them were using Internet daily, 3.3% using Internet weekly, 53.3% access 11 or more websites, while the rest accessed 10 and less websites. Then, 63.3% respondents have never heard about this system and 23.3% were unsure while the rest are not aware about SMVS.

B. The Usability of SMVS

An analysis was conducted on the respondents' responses in Section B of the post-task questionnaire. The section measures the respondents' perception towards smart Malay visualization system's usefulness, ease of use, satisfaction and security. Fig. 7-10 reported the average of the responses. The respondents mostly rated strongly agree, agree and neutral of the post-task scales on the technology acceptance model. A few respondents rated disagree for the rating of this system.

The outcomes of the evaluation suggested that SMVS is useful and easy to use. They also perceived that SMVS could help them to display the information through text easily and users can understand visualization of Malay text corpus easily and effectively. With this web application, users were able to understand the information in text easily. In terms of the user interface, the respondents reported that SMVS was easy to use without the need for written instruction and they can easily remember the way of the using this system. Furthermore, the respondents were satisfied with the appearance of this system.

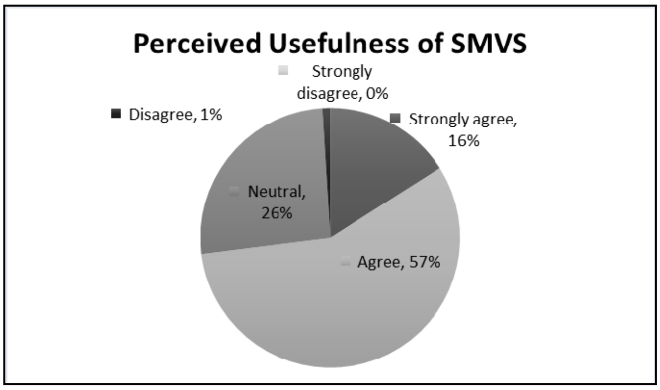

Fig. 7. The average of Perceived Usefulness of SMVS.

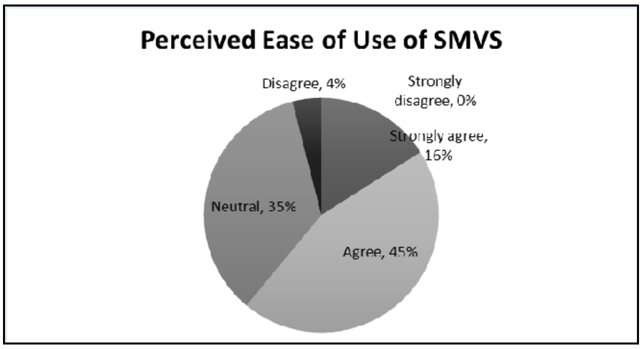

Fig. 8. The average of Perceived Ease of Use of SMVS.

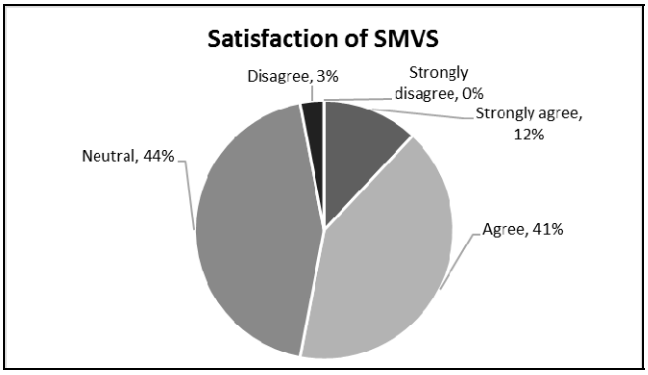

Fig. 9. The average of satisfaction of SMVS.

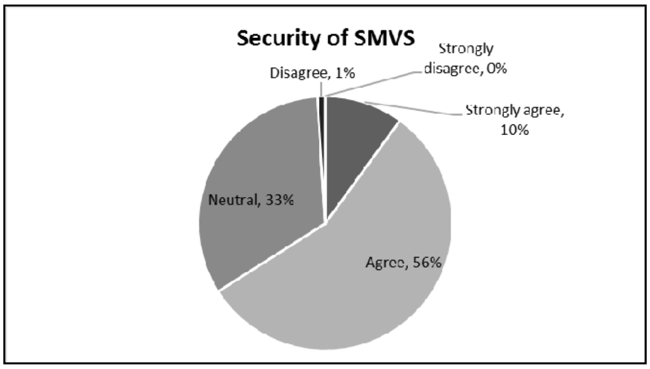

Fig. 10. The average of security of SMVS.

VI. Evaluation of SMVS

This paper describes how a system can help students, and lecturers to understand the information created through text. There are many aspects of visualization that can be studied. In the future, we plan to expend the functionality of SMVS by providing more text form verses in the Qur'an. Other than that, we also plan to make an improvement with the SMVS' design and function. Furthermore, we also plan to make the web application to be visualized from more sources and any text information such as articles or books. This can encourage users to use the web application and increase their knowledge. Hence, the users will be attracted to use this web application, because it can give them new knowledge.

Acknowledgment

We thank the Malaysian Ministry of Higher Education as well as UUM under SO Code 13849 for their support of this study.

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APPENDIX A

TABLE II. THE RESPONDENTS' RESPONSES ON THE PERCEIVED USEFULNESS OF SMVS

The post-task questionnaire items	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Average**
SMVS enhances my effectiveness on managing corpus.	0 (0.00)	0 (0.00)	1 (3.33)	22 (73.33)	7 (23.33)	4.20
I can register an account in SMVS without any error.	0 (0.00)	0 (0.00)	3 (10.00)	12 (40.00)	15 (50.00)	4.40
I can login the app with registered email and password.	0 (0.00)	0 (0.00)	1 (3.33)	16 (53.33)	13 (43.33)	4.40
The search button can function well.	0 (0.00)	0 (0.00)	0 (0.00)	14 (46.67)	16 (53.33)	4.53
I can choose time and date to set reminder.	0 (0.00)	0 (0.00)	0 (0.00)	16 (53.33)	14 (46.67)	4.47
The reminder functions according to set date and time.	0 (0.00)	0 (0.00)	3 (10.00)	11 (36.67)	16 (53.33)	4.43
It saves my time when I use this app to manage my corpus.	0 (0.00)	0 (0.00)	5 (16.67)	10 (33.33)	15 (50.00)	4.33
SMVS meets my needs.	0 (0.00)	0 (0.00)	5 (16.67)	17 (56.67)	8 (26.67)	4.10
SMVS does everything I would expect it to do.	0 (0.00)	0 (0.00)	2 (6.67)	23 (76.67)	5 (16.67)	4.10
SMVS is useful in overall.	0 (0.00)	0 (0.00)	0 (0.00)	19 (63.33)	11(36.67)	4.37

TABLE III. THE RESPONDENTS' RESPONSES ON THE PERCEIVED EASE OF USE OF SMVS

The post-task questionnaire items	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Average**
SMVS is easy to use.	0 (0.00)	0 (0.00)	1 (3.33)	22 (73.33)	7 (23.33)	4.20
SMVS is user friendly.	0 (0.00)	0 (0.00)	1 (3.33)	21 (70.00)	8 (26.67)	4.23
SMVS is flexible.	0 (0.00)	0 (0.00)	1 (3.33)	20 (66.67)	9 (30.00)	4.27
SMVS is easy to learn how to use it.	0 (0.00)	0 (0.00)	3 (10.00)	12 (40.00)	15 (50.00)	4.40
I can use SMVS without written instructions.	0 (0.00)	0 (0.00)	7 (23.33)	6 (20.00)	17 (56.67)	4.33
I can easily remember how to use SMVS.	0 (0.00)	0 (0.00)	3 (10.00)	17 (56.67)	10 (33.33)	4.23
I don't notice any inconsistencies as I use SMVS.	0 (0.00)	0 (0.00)	2 (6.67)	18 (60.00)	10 (33.33)	4.27
My interaction with the app would be clear and understandable.	0 (0.00)	0 (0.00)	3 (10.00)	17 (56.67)	10 (33.33)	4.23
I can use SMVS successfully every time.	0 (0.00)	0 (0.00)	3 (10.00)	14 (46.67)	13 (43.33)	4.33

TABLE IV. THE RESPONDENTS' RESPONSES ON THEIR SATISFACTION OF SMVS

The post-task questionnaire items	**Strongly disagree**	*a) Disagree*	**Neutral**	**Agree**	**Strongly agree**	**Average**
I am satisfied with SMVS.	0 (0.00)	0 (0.00)	3 (10.00)	22 (73.33)	5 (16.67)	4.07
I would recommend SMVS to my friends.	0 (0.00)	0 (0.00)	3 (10.00)	19 (63.33)	8 (26.67)	4.17
SMVS works the way I want it to work.	0 (0.00)	0 (0.00)	1 (3.33)	17 (56.67)	12 (40.00)	4.37
I feel I need to have SMVS app in my smartphone.	0 (0.00)	0 (0.00)	1 (3.33)	10 (33.33)	19 (63.33)	4.60
SMVS is wonderful and pleasant to use.	0 (0.00)	0 (0.00)	1 (3.33)	13 (43.33)	16 (53.33)	4.50