User Friendly System for the Visually Impaired in Learning Al-Quran

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Abstract: – This study presents a method to enable the visually impaired Muslim to learn and read the Al-Quran using Braille Display with software help. The system reads the database which contains all verses of Al-Quran and user will need to select the verse and ayah to read. Besides that, this system can be used in a class to teach visually impaired students to learn Al-Quran. Every word or character typed by the instructor in the main Braille Panel will be transmitted to the sub Braille Panel that is connected to the main Braille Panel. The selected verse of Al-Quran and ayah will also generate an index before being transmitted to the Braille Panel. The index will be transmitted to the Braille Display for people to touch and read the display. A user friendly Graphical User Interface (GUI) will be used to fulfill the ergonomics for the visually impaired user's physical capabilities. Several approaches are used to design and implement the interface for the visually impaired like speech or sound output and Braille display. The Braille codes can be displayed using the Braille panel. The design interface and structure of the system for the visually impaired users in learning Al-Quran is presented.

Key-words: - Graphical User Interface (GUI), Screen Reader, Visually Impaired People

1   Introduction

Graphical user interface (GUI) is one of the user interfaces that facilitate users in interacting with the programs or application in many ways. Besides that, GUI represents the information and actions available in the application for the user. The main objectives of the GUI are to enhance the efficiency of the application, to make the user contented and comfortable while using it, and to meet usability specifications [1]. The GUI developer needs to fulfill these objectives and analyze the target group of users that will use the application software. Since graphical elements like windows and buttons are designed for sighted users, the visually impaired can neither perceive nor use them [2]. For example, there exists a web site and system that can translate all the contents so that can be accessible by visually impaired users [3][4]. The GUI developed and discussed in this paper is targeted for the visually impaired users.

This eBraille system will be using this application software together with a specially designed electronic Braille panel that will serve as a tactile display of the screen monitor. It is crucial that we consider the ergonomics and limitations of the visually impaired users on accessing the computer and the Braille panel simultaneously. This paper presents a discussion on a dedicated GUI for the visually impaired users in learning the verses from Al-Quran.

The use of the paper embossed Al-Quran Braille presents many great challenges even though it provides those who are visually impaired to read the Al-Quran in their own way. A complete set of the paper embossed Al-Quran Braille has a vast amount of characters which caused it to be too thick and need to be printed in several volumes as show in Fig. 1. These factors bring difficulties and limitations to the teaching and learning sessions. In addition, the paper embossed Braille dots can easily wear out after repeated use and this causes difficulties in identifying the Braille characters. Besides that, the teaching sessions take place in a slow pace as the teachers need to focus on each student individually in identifying the Braille characters.

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Fig.1: Complete Printed Embossed Braille Al-Quran

In order to overcome these problems, a dedicated Electronic Braille Al-Quran Software (eBraille) is developed. It is to facilitate the visually impaired to read the Quran easily without using the existing paper embossed Braille Al-Quran. The eBraille system should be used together with the Braille Panel provided with this software. The Braille Panel is designed such that it can be used in clusters or standalone. The main advantages of this system are that no screen reader is needed and the accessibility features are built inside the application.

2 GUI Issues

Practically it is unfeasible for the visually impaired people to use any applications if the GUI design is not dedicated for them. For example, a specially designed GUI was developed for people with severely impaired vision in mathematics class [5]. Visually impaired people need a screen reader to indicate every character they type but only textual components in the application can be read by the screen reader [6]. Therefore, an eBraille system was developed by taking into account the limitation faced by the visually impaired people and the appropriate methods to facilitate them in using this software. The interface information must be properly structured to enable them to manipulate the interface efficiently and it must have similar advantages enjoyed by the sighted users.

In developing the GUI for the visually impaired people, it is imperative to understand how information is represented in Braille system. Braille is a technique to enable the visually impaired to read and write. It is a series of raised dots that can be read with fingers by people who are visually impaired and incapable of ready printed material [7]. Braille symbols are not a language but a system of codes. Braille symbols are formed within units of space known as Braille cell. A full Braille cell consists of six raised dots arranged in two parallel columns each having three dots. The dot position being universally numbered one through three from top to bottom on the left and four through six from top to bottom on the right [8]. Fig. 2 represents Braille dot positions. Sixty-four permutations are possible for each Braille cell by altering the presence of the six dots [9]. A single cell can be used to represent an alphabet letter, number, punctuation mark or any type of character. In this system, the keyboard keys that represent the dots are F as dot one, D as dot two, S as dot three, J as dot four, K as dot five and L as dot six. The SDFJKL keys are chosen because there are tiny notches at the F and J key on the keyboard. The tiny notches are the reference for the user to place their index finger for both hands at the F and J key without need to look at the keyboard. Other fingers are positioned respectively which the third finger on left hand at S key and third finger of right hand at L key [10].
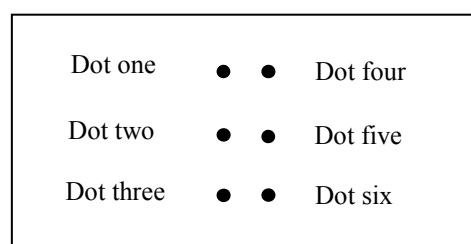

Fig. 2: Braille dot position

There are a few software applications in the market which are specially developed for the visually impaired users like Duxbury and WinBraille. Unfortunately, the main focus of these applications is for typing Braille documents and they need to be used together with screen reader software to help the visually impaired users. The users are able to type Braille codes using the keyboard and these

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applications can also translate normal text into the Braille code.

By introducing and building this proposed software, many visually impaired Muslims will be able to learn and recite Al-Quran easily without the need to have the printed Braille Al-Quran. There are some issues need to be resolved in developing the GUI for this application. These issues are:

- What module will be developed for this application,
- Would the menu will be displayed in Braille or voice or combine display of Braille and voice,
- What will be the name of the menu to be displayed,
- What shortcut key will be used for the menu,
- What keys on the keyboard to be used for the Braille codes,
- How to display the list of option of the Al-Quran verse,
- How to display chosen verse of Al-Quran.

The proposed components for this application are menu, list box, edit box, button and window. Dual interface modes are also connected to be used by both visually impaired and sighted users.

3 Software Proposed Design

The eBraille software is developed to help visually impaired Muslims in learning and reciting the Al-Quran in a simpler and more effective way. This software is divided into two modules which are teaching module and reciting Al-Quran module as in Fig. 3. The selection of modules can be made by pressing the up and down keys.
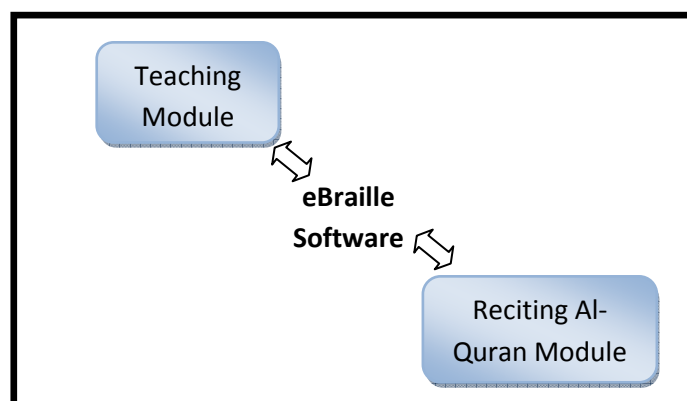

Fig. 3: Modules in eBraille Software

3.1 Teaching Module

Currently the conventional method of 'talk and Braille' [11] is used by instructor for teaching Al-Quran in classes. In the eBraille system, we developed a special module for the teaching Al-Quran. The teaching module is used by an instructor in class to teach their students how to recite Al-Quran. This module will be used together with several Braille panels that are connected to the main panel and the system. When an instructor types a character or word in the main panel, the data will be transmitted to the panels that are connected to it. Students will have the same character or word displayed on their panels equivalent to the main panel. This feature reduces the instructor's loads as they do not need to focus on every student individually. The flow diagram of the teaching module can be seen as in Fig. 4.
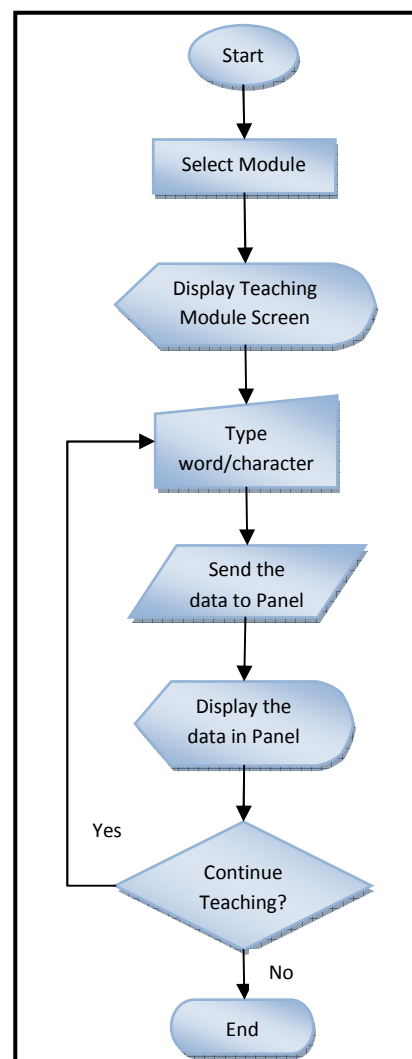

Fig. 4: Teaching Module Flowchart

In the teaching module, user can use the real time mode in which the instructor can type the Arabic character or the kalimah and the data will be transmitted directly to the Braille Panel. Alternatively, the instructor can prepare the document for teaching before the class and save the document. The instructor only needs to open the document while they are in the class through the Teaching Module in the eBraille software.

Six keys on the keyboard will be used for the typing purpose which known as the Perkin keys [12]. The keys are S, D, F, J, K and L. These keys will be used in combination to produce a unique Braille code.

The available menu in the teaching module is *open*, *save* and *create new* document as in Fig. 5. Menu can also be selected using a shortcut key. The

shortcut keys for menu are Ctrl+S (Save), Ctrl+O (Open) and Ctrl+N (New). The eBraille software was designed with user friendly interface that can be easily accessed by the visually impaired and sighted people. This software is developed with minimal use of buttons to facilitate the user.
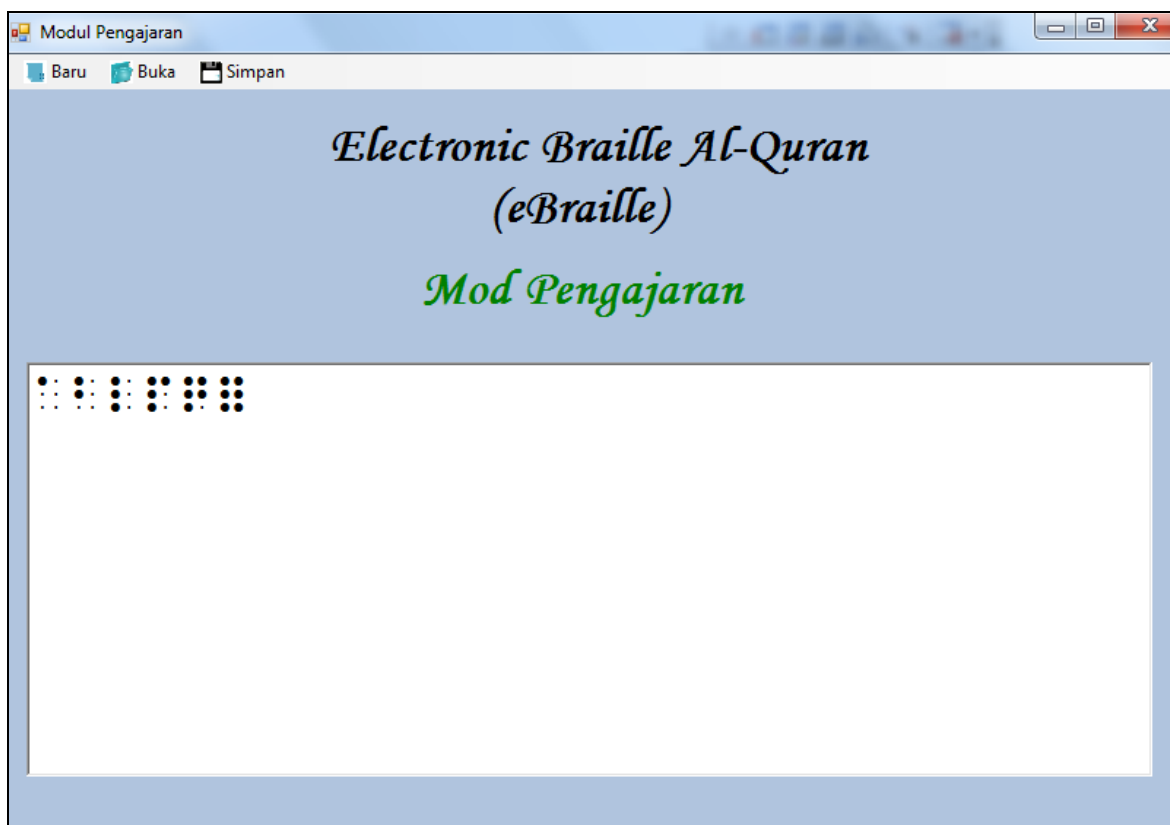

Fig. 5: Teaching Module Screen

3.2 Reciting Al-Quran Module

Reciting Al-Quran module is dedicated for the visually impaired users to recite Al-Quran in a more comfortable way. With this module, users only need to select the verse of Al-Quran and ayah that they want to recite. The flow diagram of this reciting Al-Quran module can be seen in Fig. 6.
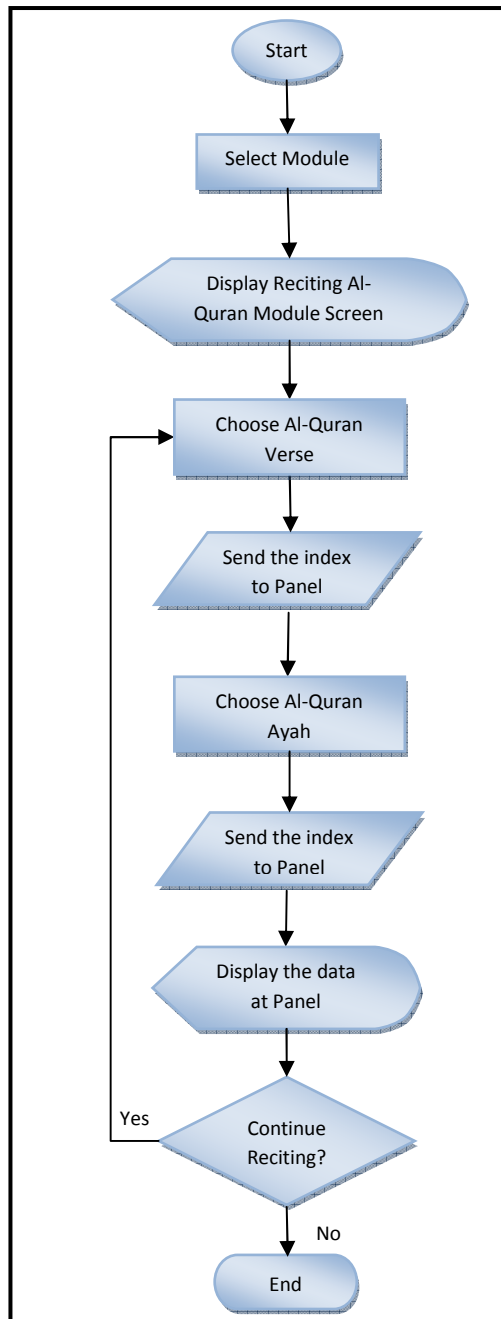
In reciting Al-Quran module, users only need to press the up and down key buttons to make the selection of the verse of Al-Quran and ayah. Every chosen button will produce a sound when pressed in order to allow the visually impaired users to identify their choices. They need to press the Enter button once they have found the verse or ayah that they want to read.

The list of Al-Quran verses will be loaded into a list box as in Fig. 7. This method is used to facilitate the visually impaired user to make selection. User only needs to press left arrow key button or right arrow key buttons to move the highlighted selection up or down. Every key pressed will produce a sound to indicate the highlighted selection. Once they have found the verse or ayah that they want to read, the user needs to press enter button and the software will display on the computer screen the selected ayah simultaneously with the display on the Braille Panel. The sound of the selected ayah will also be played.

Fig. 6: Reciting Al-Quran Module Flowchart

Fig. 7 : Menu for Reciting Al-Quran Module

The selected ayah from the Al-Quran verse will be displayed in the screen as shown in Fig. 8. However, the Braille Panel limits the characters to be displayed up to 36 characters only. For the ayah that contains more than 36 characters, the ayah will be split to several lines and every line cannot contain more than 36 characters. To move to the next line, user needs to press the right arrow key button and press left arrow key button to move backward. The current line that is displayed in the Braille Panel will be highlighted on the computer screen.
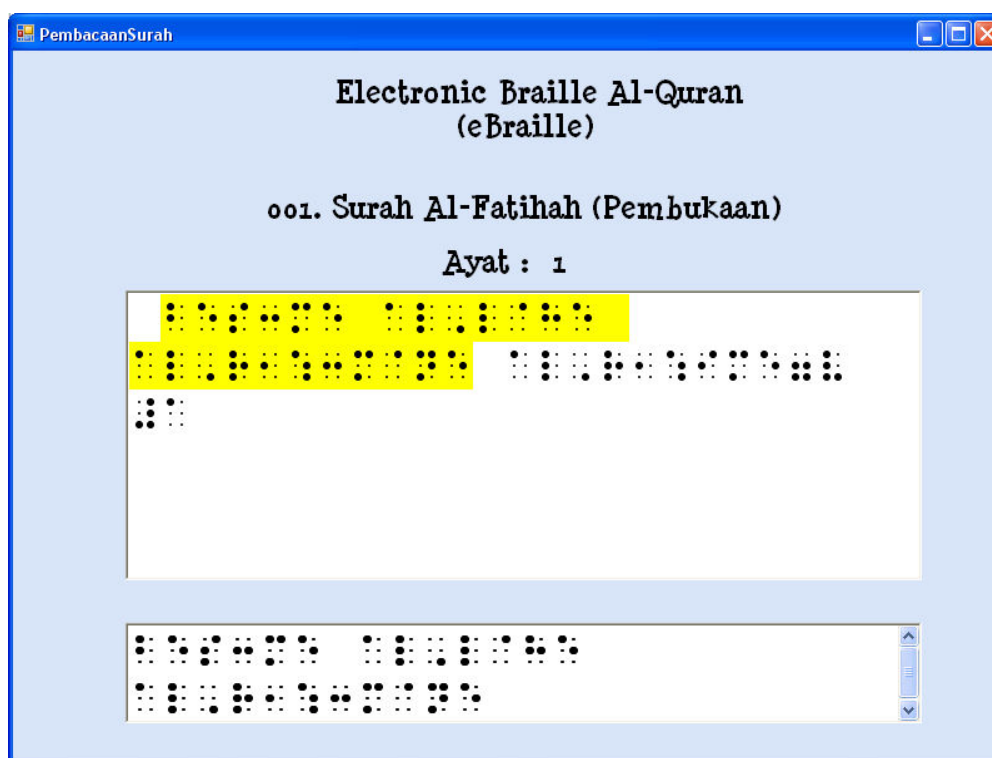
Fig. 8: Reciting Al-Quran Screen

4 Translation of Braille Code into Arabic Characters

The standard world Braille that was founded is represents the English character. The developers of the Arabic Braille systems used the English characters to represent the Arabic character then translate it to Braille code [13]. There are some works done by several developers to translate from normal language to Braille code and from Braille code to normal language [14] [15]. This is targeted for the sighted user, so they can understand the meaning of the Braille code in order to help the visually impaired user.

In the teaching module and reciting Al-Quran module, every Braille code will be translated into Arabic characters. This function is targeted for the sighted users to make them recognize the character while typing and reciting the Al-Quran.

The reciting Al-Quran module will display the selected verse and ayah where the data is retrieved from the database. The display is split into two displays which are in Braille code and Arabic

character. System will read the entire data for the selected verse and ayah before the translation to the Arabic character.

For the teaching module, every character typed by the user will be translated to a unique Arabic character. Every single Braille code represents a unique Arabic character. The system reads the Braille codes from the keyboard and translates to Arabic character. For example Alif(ا) is represented by Braille dot one as in Fig. 9. Table 1 shows Braille code represented in Arabic and Roman.
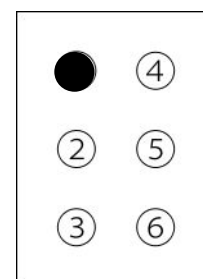

Fig. 9: Character Alif in Braille code

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Table 1 : Braille code represent in Arabic and Roman

Braille code	Arabic	English	Braille code	Arabic	English	Braille code	Arabic	English
a	ا	a	q	ق	q	9	(ـَ)	9
b	ب	b	k	ك	k	5	(ـُ)	5
t	ت	t	l	ل	l	,	ﻢ	,
?	ث	?	m	م	m	3	(ﻩ)	3
j	ج	j	n	ن	n	f	ف	f
:	ح	:	w	و	w	$	ض	$
x	خ	x	h	ه	h	)	ط	)
d	د	d	v	لا	v	=	ظ	=
!	ذ	!	&	ص	&	(	ع	(
f	ر	r	I	ى	i	<	غ	<
z	ز	z	1	(ـَ)	1	i	(ـُ)	u
s	س	s	e	(ـِ)	e	2	(ـّ)	2

5 Transmission Data to Braille Panel

The eBraille system will use a serial connection for transmitting data to the Braille panel. The serial connection will have one wire for data and all the data will transmit over this wire to the Braille panel in a serial fashion one bit after another [16].

In Reciting Al-Quran Module, every selected verse and ayah by user will produce an index. Once the user presses the enter key after they select the verse or ayah that they want, the system will generate the index and the index will be placed in an array as a bit format. For example the Al-Fatihah verse and the first ayah will be assigned the generated index of 001-001. The value 001-001 will be converted to a bit format and placed in an array. Then the array will be transmitted to the Braille panel for the display purposes through the serial connection. When the Braille panel receives the index, the program in the Braille Panel will retrieve the data based on the index transmitted by the eBraille system. Then the data will be displayed in the Braille Panel equivalent to the display on the screen of eBraille system. Once the end of the line of the ayah is reached users only need to press the next key to go to the next line of ayah. When the next key is pressed, the system will generate a new index and the same transmission process will occur.

This process will be repeated until it reaches the end of the verse or the user presses the Escape key.

In Teaching Module, every character typed by the instructor will be directly transmitted to the Braille panel through serial connection. The system will send the key value for each key pressed and Braille panel will display the Braille code representing by the value in Braille panel.

6 Audio Help for User

As we reviewed the Braille software available in the market, it was found out that the software house only provides and develops software that facilitates visually impaired user to type documents. Furthermore, users need to install third party software's for screen readers to make them recognize the texts that appear in the screen easily [17]. If there is no screen reader installed in the computer, the software will be meaningless for them as they will not know what they are typing [18]. With this eBraille software, every menu that the user selects produces audio to indicate the menu. This function will facilitate the visually impaired user as they do not need to purchase third party software to enable them to use this software properly.

7 Feedback from Users

The proposed eBraille software differs from the paper embossed Al-Quran Braille. According to the visually impaired users that had used the eBraille software prototype, they are satisfied with the flow and process of the software. This eBraille system makes it easy to learn and recite Al-Quran. Every button and menu in the eBraille software are embedded with audio to indicate the buttons and menus. This approach makes it easy for the user to know their selection as we know their limitations as visually impaired users. Besides that, the audio that is used by this software to indicate every menu and selection are clear and comprehensible by the users. The minimal use of buttons and a very user friendly GUI is suitable not only for the visually impaired users but also for the sighted users.

8 Conclusion

From this study we can conclude that the dedicated system for learning Al-Quran can help visually impaired users to learn Al-Quran in an easier way. Furthermore, the eBraille software developed had considered all the limitations and capabilities of those users to make them feel comfortable to use the software and make full use of all features available in the application. The user friendly GUI and the minimal use of buttons in the eBraille software make it easy to be handled by the visually impaired users with their abilities.

9 Acknowledgement

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