Journal of Engineering Science and Technology
Special Issue on INCITEST2020, October (2020) 1 - 9

ANALYSIS OF INTERACTION DESIGN IN BRAILLE AL-QUR'AN LEARNING APP FOR VISUALLY IMPAIRED PEOPLE

ADAM MUKHARIL BACHTIAR*, DIAN DHARMAYANTI, FITRI FEBRIANA

Informatics Engineering, Faculty of Engineering and Computer Science,
Universitas Komputer Indonesia, Jalan Dipatiukur Nomor 112-116,
Bandung, Jawa Barat, Indonesia
*Corresponding Author adam@email.unikom.ac.id

Abstract

This research was conducted to help User Interface/User Experience (UI/UX) designer to produce appropriate UI/UX design on braille Al-Qur'an learning application for visually impaired people. For this objective, basic steps of the interaction design activity was carried out with participatory design approach. Using this approach, the resulting interaction design concepts can be adjusted to the perspective of visually impaired people. The main content of the discussion including understanding user, creating conceptual design, wireframing, prototyping, and testing/evaluating. The resulting interface design is then implemented in the form of a native prototype. Based on the results of testing the prototype of the Al-Qur'an braille text learning application, the average value of the performance fulfilled the purpose of the test. Thus, it can be concluded that the interaction design model of the Al-Qur'an braille text learning application produced in this study has reached its goal and is proper for visually impaired people.

Keywords: Braille, Interaction design, Participatory design, UI/UX, Visually impaired.

1. Introduction

Every Muslim has the right to receive Al-Qur'an education including people with disabilities such as those who are visually impaired. Braille Al-Qur'an instructor at PSBN Wyata Guna said that the media used by these people are Al-Qur'an manuscripts that use braille lettering. When they use it, they rely on their sense of touch while listening to lectures from instructors. They also tend not to be able to learn independently, especially if their sense of touch is not sensitive. Meanwhile, the number of instructors was limited. To handle this, braille learning application can be introduced. To figure out the overall user experience in interacting with existing braille learning application, usability testing was conducted with clients at PSBN Wyata Guna. Based on this test, it was found that participants were having difficulty and did not understand how to interact with the application. Only 1 out of 5 participants succeeded in completing the assigned tasks with the average time of more than 5 minutes. The average overall relative efficiency of the application was only 14.85% [1]. It can be seen that the interaction design of the braille learning application being tested was still in conflict with accessibility and usability aspect [2].

Based on above explanation, further observation was required to figure out the appropriate interaction design model to be implemented in the braille Al-Qur'an learning application. For this objective, basic steps of the interaction design activity were used with participatory design approach. This approach was used in order to allow the end-user, which in this case is visually impaired people, to participate in creating the conceptual design. Using this approach, the resulting model cannot be adjusted only to their behaviour and tendencies related to the use of smartphones and braille Al-Qur'an learning process but also adjusted to the interaction they determine on their point of view and personal expectations [3].

2. Research Methodology

The methodology used in this research is presented in Fig. 1. The stages of basic interaction design activities were carried out based on reference [4].

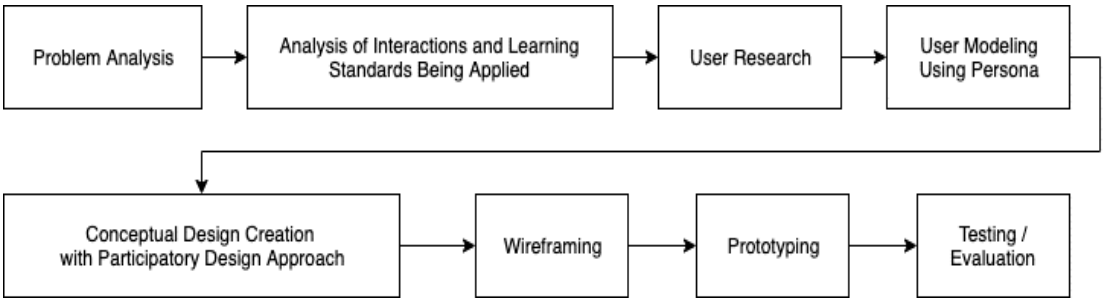


Fig. 1. Research methodology.

3. Results and Discussion

3.1. Problem analysis

The braille learning application has the potential to help visually impaired people to learn the Al-Qur'an braille text. However, through usability testing, it was found

that users could not interact with the application. Therefore, it is necessary to know what kind of design model to be applied [5, 6]. This stage aims to specify the root problems based on the results of usability testing that has been done previously. In this usability testing, each participant was given 2 tasks: (1) finding "Help" content and (2) learning one of the braille symbols. Each pain point experienced by participants related to these tasks is mapped on the journey map as shown in Table 1. Opportunities were mapped out, and they could contribute the formulation of design hypotheses required for the stage of conceptual design.

Table 1. Example of journey map (task 1).

Step	Pain Point	Opportunity
Holding smartphone	1. Unaware that the application had landscape orientation 2. Unaware of the active interface elements 3. Unaware of the page they were on 4. Unaware with two-finger swipe interaction (for right and left direction)	1. Application has portrait orientation 2. Apply one-finger swipe interaction for right and left direction 3. Apply two-finger swipe interaction only for vertical scroll 4. Optimizing the description of each interface component so that it is readable by screen reader
Browsing menu	Unaware if there was menu other than Learning menu (tend to select 1st menu)	Display the entire menu on the start page in a list sorted by priority
Select Help menu	-	-
Explore content of Help menu	The help content was not read by the screen reader	1. Presenting more informative help content when the application opened 2. Add "content description" attribute for each UI element

Based on the journey map, in the use of smartphones, visually impaired people are very dependent on the voice element presented by the screen reader. Meanwhile, the interaction design of the braille learning application did not support the use of a screen reader.

3.2. Analysis of interactions and learning standards being applied

At this stage, an appropriate interaction was mapped for each applicable teaching method in Wyata Guna PSBN. This is shown in Table 2.

3.3. User research

Interviews were conducted to collect data from eight potential users. This data includes behaviours, tendencies, characteristics, and preferences related to the experience of smartphone usage and braille Al-Qur'an learning. The data obtained are synthesized to model the target user using persona [5]. The determined population was the clients of PSBN Wyata Guna who often use smartphone in their daily lives and has graduated from the basic class at the institution. This was based on insight gained from pre-research interviews to be able to learn the Al-Qur'an braille, students must already understand Latin braille.

Table 2. Mapping of interaction to teaching method [3].

Lesson	Teaching Method	Interaction
1. *Hijaiyah* Braille	Lecture	1. Provide verbal statements about certain braille symbol
2. *Harakat* Braille		2. Provide images that represent certain braille symbol
3. Merge of *hijaiyah* braille with *harakat* braille	Exercise	1. Provide exercise questions that ask about the braille points that form certain symbol 2. Provide buttons that the user can use to answer and explain the braille points of certain symbol 3. If the user's answer is correct, then provide feedback that the answer is correct accompanied by the answer itself 4. If the user's answer is incorrect, then provide feedback that the answer is incorrect, and an option that allows the user to try again 5. If the user's answer is incorrect twice, provide feedback that the answer is incorrect accompanied by a corrective statement

3.4. User modeling using persona

The data collected from user research then analysed and synthetized to model target user in form of persona. The stages carried out in persona creation include: (1) identification of behavioural variables, (2) mapping participants to behavioural variables, (3) identification of significant behavioural patterns, and (4) expand description of persona attributes and behaviour (See Fig. 2) [5].

3.5. Conceptual design creation with participatory design approach

At this stage, participatory design activities were carried out with five participants who have characteristics as stated in persona. Conceptual design produced in the form of usage scenarios [7].

3.5.1. Framing

Before conducting this stage, the following steps were carried out: (1) determining the design hypotheses (based on the results of previous stages for becoming references in the establishment of the next stages (i.e., problem analysis, teaching methods and interactions resulting from the analysis of existing learning and interaction, as well as the behaviours and characteristics of the visually impaired listed in the persona)) [8], and (2) identifying methods. The steps are for visually impaired users. Participatory activities were a concept for the improvement activities [9].

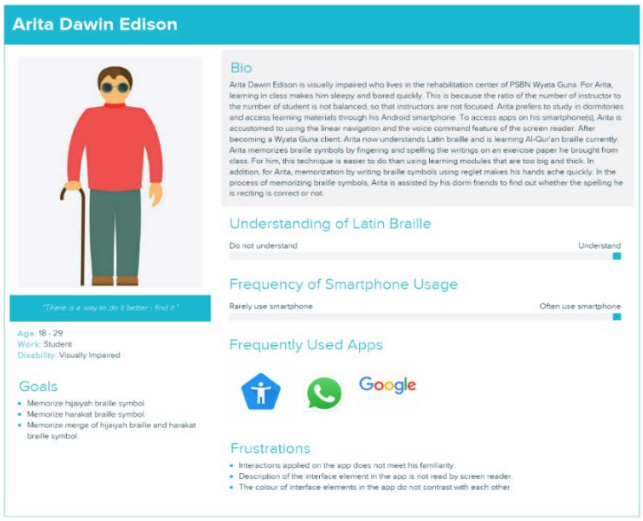


Fig. 2. Persona of target user.

3.5.2. Planning

At this stage, procedures carried out in the "facilitating" and "analysing" stage were planned. This includes making initial concept that were going to be evaluated and refined with participants. The initial concept was arranged in form of a scenario maps based on hypotheses formed at "framing" stage. Example of the scenario map as shown in the Table 3.

3.5.3. Facilitating

Procedures that has planned previously were executed at this stage. After they were presented narratively, participants were asked to think creatively within the time. They were asked to come up with ideas for the refinement according to their respective perspectives and expectations. The example of refined scenario based on participant's idea as shown in Table 4. This example is a refined scenario by low vision participant.

3.5.4. Analysing

All ideas contributed at the previous stage were then analysed. It aims to formulate ideas that might be applied and make decisions for conflicting ideas between participants. Thus, concept ranking was carried out, i.e. each participant gave score

to these ideas with 1 to 10 scale [**8**]. After that, the whole design concept was drafted which included selected ideas based on the results of concept ranking. This concept was then evaluated with participants by simulating interaction in the form of dialogue. Through this evaluation, the final design concept was improved and determined with the participants. For the intended design concept to be more illustrated, from the form of narrative scenarios was made into storyboards [**9**]. Based on the formed storyboard, it can be known the flow of the stages and the page that the user passes to achieve his goals. In addition, the interaction with the design requirements specifications can be discovered. These points become references to form the application prototype interface design in the next stage.

Table 3. Example of initial scenario map (case: learning *hijaiyah* braille).

Step	Interaction	Design Requirements
Open the application	Hold smartphone with portrait orientation	The screen reader reads "Swipe to find menu, then double-tap to select" in Indonesian
Find menu of Learning *Hijaiyah* Braille	Swipe right and left with one finger	The screen reader reads "Menu of Learning *Hijaiyah* Braille" in Indonesian
Open menu of Learning *Hijaiyah* Braille	Double-tap	-
Find a braille symbol	Swipe right and left with one finger	The screen reader reads "<letter symbol name>. <braille points (numbers) forming the letter symbol>" in Indonesian
Open the detail page of selected braille symbol	Double-tap	-
Explore braille symbol detail page	Swipe right and left with one finger	1. The app displays the letter symbol 2. The screen reader reads the name of the symbol as well as the description of the active braille point number and its location

3.6. Wireframing

Examples of digital mock-ups that were designed based on the storyboards and google material design accessibility guide are shown in Tables 5 to 6.

3.7. Prototyping

A native prototype was built on Android platform. The user experience in the testing phase could be in accordance to the actual usage context. For visually impaired smartphone users, they need the sound component from the screen reader [9]. Digital mock-ups designed previously was implemented in this prototype with interactions referring to the storyboard. The overall interaction design of this prototype is visualized in the form of user flow as shown in Fig. 3.

Table 4. Example of *refined* scenario map (case: learning *hijaiyah* braille)

Step	Interaction	Design Requirements
Open the app	Hold smartphone with portrait orientation	1. The screen reader reads "Swipe to find menu" in Indonesian 2. The background colour of the application is dark with bright colours for interface elements
Find menu of Learning *Hijaiyah* Braille	Swipe right and left with one finger	1. This menu must be at the top as level 1 2. The screen reader reads "Double tap to learn *hijaiyah* braille" in Indonesian
Open menu of Learning *Hijaiyah* Braille	Double-tap	The screen reader reads "Swipe to find letter symbols" in Indonesian
Find a braille symbol	Swipe right and left with one finger	1. The list of letter symbols is displayed in ascending order from '*alif*' to '*ya*' 2. The screen reader reads "<letter symbol name>. <braille points (numbers) forming the letter symbol>. Double tap for the details of this symbol" in Indonesian
Open the detail page of selected braille symbol	Double-tap	The screen reader reads "Swipe to explore symbol details"
Explore braille symbol detail page	Swipe right and left with one finger	1. The application displays the shape of letter symbol 2. The screen reader reads the name of the letter symbol and also the description of the points (numbers) 3. The information about the location of the point is no need to be given 4. All interface elements must be labelled

3.8. Testing / evaluation

At this stage, a native prototype testing was performed with usability testing method [1, **6**]. The tasks were successfully completed with a success rate of 95%. 4 out of 5 participants successfully completed with better tasks, while 1 participant completed 3 of 6 tasks with poor tasks. The overall relative efficiency value reached an average of 83.59% and the level of user satisfaction reached 4.2 / 5. For evaluation of learning, user understanding of the braille Al-Qur'an before and after using the prototype was compared. From this, it can be seen that the success rate increased from 41.33 to 78.67%, approaching the success rate determined by the Wyata Guna PSBN, which is 80%.

Table 5. Main menu.

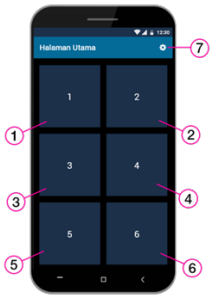
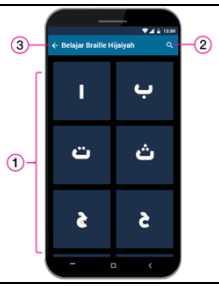
Screen	Specification
	Screen Name: T01 – Main Background Color: Black Font: Roboto Element: 1. Card of "Learning *Hijaiyah* Braille" 2. Card of "Learning *Harakat* Braille" 3. Card of "Learning Merge of *Hijaiyah* & *Harakat* Braille" 4. Card of "Exercising *Hijaiyah* Braille" 5. Card of "Exercising *Harakat* Braille" 6. Card of "Exercising Merge of *Hijaiyah* & *Harakat* Braille" 7. Settings icon Function: (1) Go to T02, (2) Go to T03, (3) Go to T04, (4) Go to T05, (5) Go to T06, (6) Go to T07, (7) Setting application display color

Table 6. Menu of Learning *Hijaiyah* Braille

Screen	Specification
	Screen Name: T02 – Learning *Hijaiyah* Braille Background Color: Black Font: Roboto Element: 1. Card of "*Hijaiyah* Symbol Details" 2. Search icon button 3. Back arrow icon button Function: (1) Go to T08, (2) Search for a braille symbol, (3) Back to T01

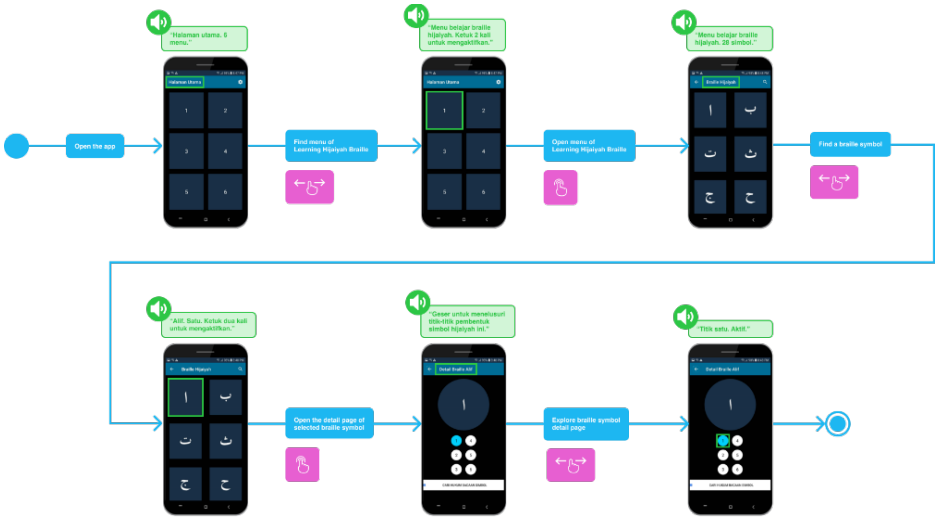


Fig. 3. Example of user flow (case: learning *hijaiyah* braille).

4. Conclusion

The interaction design model that results from this research can be used well by the visually impaired people. The value of efficiency and user satisfaction has also increased compared to the use of existing model. For further research, learning standards that apply in advanced lessons can be applied with more usable and accessible interactions. In addition, if the interaction applied requires a speech recognizer, it is better if the speech recognizer is able to recognize speech in different formats.

References

1. Syatri, J. (2016). Pengajaran Baca Tulis Al-Qur'an bagi Tunanetra: Studi pada Tiga Lembaga. *SUHUF Jurnal Pengkajian Al-Qur'an dan Budaya*, 9(2), 363-392.
2. Frauenberger, C.; Good, J.; and Keay-Bright, W. (2011). Designing technology for children with special needs: bridging perspectives through participatory design. *CoDesign*, 7(1), 1-28.
3. Xiao, J.; Joseph, S. L.; Zhang, X.; Li, B.; Li, X.; and Zhang, J. (2015). An assistive navigation framework for the visually impaired. *IEEE Transactions on Human-machine Systems*, 45(5), 635-640.
4. Da Silva, T. S; Silveira, M. S.; Maurer, F.; and Hellmann, T. (2012). User experience design and agile development: From theory to practice. *Journal of Software Engineering and Applications*, 5, 743-751
5. Adhoni, Z. A.; and Siddiqi, A. A. (2013). A programming approach for the digital Quran applications. *International Journal of Engineering and Computer Science IJECS-IJENS*, 13(5), 26-35.
6. Kahn, P; and Lenk, K. (1998). Design: principles of typography for user interface design," interactions, 5(6), 15.
7. Dharmayanti, D.; Bachtiar, A. M.; and Wibawa, A. P. (2018). Analysis of User Interface and User Experience on Comrades Application, *IOP Conference Series Materials Science and Engineering.*, 407(1), 012127.
8. Petrie, H.; and Bevan, N. (2009). The Evaluation of Accessibility, Usability, and User Experience. *The Universal Access Handbook*, 1, 1-16.
9. Toby, B. H. (2001). EXPGUI, a graphical user interface for GSAS. *Journal of Applied Crystallography*, 34(2), 210-213.