Augmented Reality Operational Framework to Aid Al-Quran Memorization for Hearing Impaired Students

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Abstract

Education 4.0 is new era in educational sector, it transform the traditional teaching with the new innovation of technology in the pedagogical learning method. Nowadays, Augmented Reality is applied in the education area to prompt and enhance students’ learning ability. Islamic education is not spared from this; innovations in Islamic educational materials should be enhanced so that students are able to learn better, especially among the special needs students. Hearing impaired students faced difficulty in memorizing the Al-Quran by arranging the sequence verses of surah in a correct sequence. Hence, this research work is aimed at developing an integrated mobile application which can assist the Quran memorization among the hearing impaired students. The attributes for developing an application for hearing impaired students are identify and the operational framework is develop to meets the Augmented Reality environmental development requirement which makes the process of developing the application are smooth and runs well. The proposed operational framework is develop based on AR Based content elements that are used to develop Augmented Reality application. Thus, it provides guideline for developing application to aid Al-Quran memorization for hearing impaired students.

Keywords: Augmented Reality, Education 4.0, Hearing Impaired, Al-Quran Memorization, Al-Quran Education

1. Introduction

Industrial Revolution 4.0 has changed the direction of an organization in achieving its goal[1]. The changes of industries has given impact towards education sector which introduced the term of Education 4.0[2]. The revolution of 4.0, has introduced new innovation of technology such as Augmented Reality (AR) in the education sector. Thus, this has attracted many researchers and industrial players to deeply discover the potential of AR technology toward students learning environment[3]. The same goes with Islamic education, there is a need for Islamic teaching materials and approaches to be integrated with technology especially among the Hearing Impaired (HI) students[4]. The Quran is a book that is compulsory for each Muslim to learn including the disabled. Nevertheless, Al-Quran education is less common among the HI[5]–[7] as many people believe that HI community is being given the exception to learn Al-Quran. This belief has made learning Quran among the HI children to be less important and to a certain extent, taken for granted.

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A memorization method called Tahfz Akhyar has been introduced to enable HI children to learn Al-Quran[8]. However, these students faced difficulty in arranging the verses of surahs in a correct sequence and made mistakes while arranging the verses of surahs[9]. Thus, the use of technology can help HI students to learn Al-Quran better and eventually improve the students learnability[10] as well as the memorization quality[11]. Therefore, the objectives of this article are; i) to identify the attributes or criteria to develop the AR application for HI students; and ii) to develop the operational framework that provides guideline to develop application that aid Al-Quran Memorization for HI students by using AR technology.

1.2. Education 4.0

The revolution in manufacturing industries has been impact the education sector to shift from traditional teaching to Education 4.0[2]. The transformation from Education 1.0 to Education 4.0 are parallel with the Industry Revolution. Education 1.0 was known as agricultural society where in this era the knowledge is transferred from teacher to students by using the concept and comprehensive study[12]. The students will solidly focus on teacher explanation to gain the knowledge. Then, Education 2.0. It was known as industrial society with the concept of teaching rather than being creative, the management focused on learning the technology as a tools to use in the work[12]. Next, Education 3.0 addressed the need of technology society where it creates knowledge by supporting self-learning in which the learning technology provided in the form of teaching materials, digital media and social media. However, education in this era, empower students to generate knowledge only, not merely to consume[12]. Finally, Education 4.0 is known as innovative society where it covers with special characteristics of parallelism, connectivism and visualization. The main focus of learning management is to help the student’s ability to apply the new technology in which the students are able to grow with the knowledge and skills for the whole life[12]. The education revolution is summarize in Table 1.

<table>
<thead>
<tr>
<th>Revolution</th>
<th>Education 1.0</th>
<th>Education 2.0</th>
<th>Education 3.0</th>
<th>Education 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society</td>
<td>Agricultural Society</td>
<td>Industrial Society</td>
<td>Technology Society</td>
<td>Innovative Society</td>
</tr>
<tr>
<td>Explanation</td>
<td>Knowledge is transfer from teacher to students</td>
<td>Knowledge is transfer from teacher to students</td>
<td>Knowledge is transfer from teaching materials, digital media and social media</td>
<td>Help to sustain the knowledge and skills by applying new technology for the whole life</td>
</tr>
<tr>
<td>Teaching Method</td>
<td>Comprehensive Explanation</td>
<td>Explanation and Technology as a tools</td>
<td>Technology as a tools</td>
<td>Parallelism, Connectivism and visualization</td>
</tr>
<tr>
<td>Focus</td>
<td>Concept and Comprehensive Study</td>
<td>On how to use technology</td>
<td>Empower students to get the knowledge</td>
<td>Knowledge sustainability and practice</td>
</tr>
</tbody>
</table>

The Education 4.0 will combine real and virtual world information[13]. According to Ciolacu, Tehrani, Beer, & Popp(2017) education technology in Education 4.0 consist of personalized learning process, game based learning using Virtual Reality/Augmented Reality (VR/AR), communities of practice, adaptive technologies, learning analytics, intelligent Chabot’s and E-Assessment as shown in Figure 1.
1.3. Augmented Reality

AR refers to the augmentation or meditate a digital information like graphics, video, GPS into the real environment by utilizing the device camera[15]. [16] states that AR refer to the mixed reality that combines the real environment and virtual environment that is in a single display. Fig. 2 show the reality-virtuality continuum, AR is known as Mixed Reality (MR) that can be an interchange between the real environment and virtual environment.

![Reality-Virtuality Continuum](Source: Milgram et al., 1994)

AR learning method has been implemented in schools subject such as science[17], sign language[18], geometry[19] and others to help the HI students to understand and gain new knowledge. Figure 3 and Figure 4 shows AR technology HI students to learn science subjects and sign language.

![3D Microscope](Source: Milgram et al., 1994)

![Sign Language](Source: Milgram et al., 1994)
1.3. Background of Problem

The use of AR in the education system from preschool to tertiary can be seen from the implementation in classrooms such as in pre-school science subject[20], science subject in secondary school[21], astronomy[24] and computer science[22]. However, according to [3], there is a need for Islamic learning materials to be incorporated with modern methods and technologies.

Learning the book of Quran is compulsory for all Muslims. It is a gift from Allah to all Muslims as it has explanations, warnings, and guidelines for Muslims and others on how to live life here and in the world hereafter. All Muslims regardless of age, gender, race, ability or wealth are required to learn Quran. However, the method in learning Quran among HI students’ needs to be improved[5]–[7]. This is due to the notion that many people believe that having hearing impairment is an acceptable excuse to not read the Quran[10]. Moreover, people with hearing problem have difficulty to hear and utter sounds as Quran is usually taught by reading repeatedly and hearing how the word is pronounced with good makhraj and tajweed[10]. Not only that, they also use sign language, writing, and gesture acts as the communication medium[5], [23] that requires all words to be translated into the sign language. However, many of HI are not able to understand or grasp something abstract and some of the Islamic terms[24]. Therefore, Tahfiz Akhyar, the Al-Quran memorization method was introduced by Hj Norakyairan Hj Raus and Zaharatul Sophia Mohamed Amir Abas in 2014 that is based on Prophet Muhammad’s teaching method to memorize doa, zikr, selawat and solah[25]. The method is based on arranging the pieces verses of surah in Al-Quran in the correct sequence. However according to[9] HI students faced difficulty in arranging the verses of surah in the correct order and made mistakes when arranging the verses of surah. Thus, the use of technology can help the HI students to learn Al-Quran better and eventually can improve the students’ learnability[10] as well as the memorization quality[11].

2. Previous Methodological Review

To achieve the paper objectives, the attributes or criteria to develop AR application are achieved by comparing the previous work to develop technology for HI community. Moreover, the software development also were being identify.

2.1. Attribute for Application Development

To achieve the objective, so as to identify the interface attributes or criteria, there have been several previous studies conducted among the HI students on learning using technology. Table 2 illustrates the applications that have been developed for the HI students. In this article, there are three categories of application were developed based on the mobile, web-based and Augmented Reality (AR) that are related to HI learning. Colors, texts, images and sign language are the main criteria used in these applications to capture the students’ interest and also to create a user-friendly interface as the HI students are visual learners[26]. Other attributes such as number, sounds and video were also used in those applications. Moreover, the applications were run on the various platform such as Android, IOS, desktop, mobile, PDA and Head-Mounted Display (HMD) in which some of the applications combine a gesture recognition and both Automatic Speech Recognition (ASR) and Text-to-Speech Synthesis (TTS) technologies to help and improve the HI learning experience.
### Table 2. Applications for the Hearing Impaired Student

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Application Name</th>
<th>Colour</th>
<th>Text</th>
<th>Image</th>
<th>Sign</th>
<th>Number</th>
<th>Sound</th>
<th>Video</th>
<th>Platform</th>
<th>Extra Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huo et al.  (2014[4])</td>
<td>mTalk</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>Android</td>
<td></td>
</tr>
<tr>
<td>Nor Aziz Binti Mohd Daud, Noorazan Jumhari, (2013[7])</td>
<td>iTalk</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>IOE</td>
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<tr>
<td>Husseini &amp; Mutalib, (2014[15])</td>
<td>iTalk</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>Android</td>
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<tr>
<td>Web-based</td>
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<tr>
<td>Zarrella et al. (2010[16])</td>
<td>CopyCat</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>✗</td>
<td></td>
<td></td>
<td>Gesture recognition</td>
<td></td>
</tr>
<tr>
<td>(Mohd &amp; Shamsul Anwar, 2014[1])</td>
<td>Islamic module</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Augmented Reality (AR) Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mokhtar et al., (2012[19])</td>
</tr>
<tr>
<td>Jones et al., (2014[20])</td>
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<tr>
<td>Hazaro, Amincar, &amp; Netto,  (2014[21])</td>
</tr>
<tr>
<td>C-J Chen, Chin-Yu Lin  , Hsi-Chen Chia, Kui-Jung Wung and Y-M. Huang, (2016[22])</td>
</tr>
</tbody>
</table>

**TOTAL**: 7/10  8/10  6/10  7/10  2/10  1/10  5/10

#### 2.2. Prototype Model

A prototype model is a software that is developed and partially produced and it is examined by both user and developer[27]. Figure 5 depicts the prototype model that consists of sequence phases, in which the next phase can be executed after the current phase has been completed. The four main phases are:

i. Determining the basic requirement.
ii. Developing the initial prototype.
iii. Reviewing the prototype by users.
iv. Revising and enhancing the prototype by developers.

![Figure 5. The Sequence Prototype Model (Source: Mat Amin,2007)](image)

Figure 6 shows the process of the prototype model. It is iterative in which the version of the proposed prototype will be updated based on the users’ feedback until all the requirement has been fulfilled[30]. Once the proposed prototype has met the users’ satisfaction, the iterative cycle will be stopped as it has already achieved the development objective.
This prototype model has several advantages. It takes less time to be developed. Hence, it is economical and takes a shorter time to be delivered. In addition, it is able to satisfy users’ learning and it also helps developers to define and refine the system requirement. Moreover, it can be integrated with other model and the training would then start earlier in the life cycle[27].

2.2. AR Based Content Model

ARBC model was introduced by[28] specifically for AR development process that consists of five phases which are analyse, determine, produce, use and evaluate as shown in Figure 7.

Figure 7. AR Based Content (ARBC) Model (Source: Aqel, 2017)

A brief explanation on each step is given in the following paragraphs:

i. Analyse
   In this step, a problem needs to be identified and the system requirements need to be gathered to understand the purpose of employing AR technology

ii. Determine
   Developers need to clearly define the objectives of the content in order to understand the purpose of AR development, determine teachers’ or students’ role in using the application. In addition, the application’s interface such as the object and its colors, dimension and the movement in the system needs to be described. Besides, soft-ware and hardware requirement need to be determined in order to produce the objects that are needed for the application, the type of software authoring (Adobe Illustrator, 3DMax, AR builder and Aurasma or Unity) and the types of hardware needed (personal computer, tablet, projector, High-Definition camera or Kinect camera) should be well clarified. Moreover, the learning environment that includes the lighting, electricity supply, safety features and ventilation should also be described.

iii. Produce
   In this step, the AR objects will be produced to develop the AR application. The objects can be in either 3-Dimension (3D) or 2-Dimension (2D). They need to be designed by using the suitable software that has been identified. Also, in this phase there is a need to design the marker which is related to the objects
and this is done by employing suitable software to connect both marker and objects.

iv. Use
The developed application is applied in classroom to measure or observe students’ improvement in their learning. Teachers then need to train students to use the application, observe their interactions, monitor their learning strategies, do a lot of reinforcements and provide ample motivations to students.

v. Evaluate
The evaluation or feedback from users is taken into account in evaluating the effectiveness of the software application and its implementation. In this step, the AR evaluation needs to be carried out to determine whether it runs smoothly without an error or bug, the objects appear in correct manner and students understand the whole content or otherwise.

3. Proposed Methodology

Figure 8 shows the operational framework of AR application to memorize Al-Quran for HI students to meet the paper objectives. In this article, there are three main phases which are Preliminary Study, Application Development and Testing & Evaluation phases. The three phases are based on the combination of prototype model and AR Based Content Model. Meanwhile, the criteria or attributes that has been identify are used during application development in determine process to develop the AR application.

![Figure 8. Operational Framework to develop the AR Application](image)
3.1. Phase I – Preliminary Study

Based on Figure 8, phase I involves four research activities which are literature review, conducting an interview with teacher, make an observation to HI students and conclude the problem statement based on the preliminary study result. The outcomes of this phase enable the understanding of the HI students learning behaviour towards the Quranic education.

3.2. Phase II – Application Development

Phase II is the development process in which the prototype is produce to aid Al-Quran memorization for HI students. Each process in this phases are explain as follows:

i. Analysis
   Analysis process is an early process to gather the required information for the development purpose and understand the arising issues. This process is carried out during the preliminary study that occur in phase I.

ii. Determine
   In determine process, all the information from previous process is filtered and suitable information are selected. All the software, hardware and application development interface, attributes or criteria is determine and listed in this process to ensure the production of AR application is well develop and run smoothly. To develop the object and AR application, software authoring such as Adobe Illustrator, Adobe Photoshop, Unity 3D and Vuforia are used. Moreover, as the mAR-Quran application is develop for android platform, the android smartphone or tablet will be used to ensure the compatibility with the operating system. The content of application such as scaffolding, module, color, shape is determine in this process.

iii. Produce
   Once the information has been identify, the AR application is develop in this process. A prototype is produce during this process.

iv. Use
   Once the users is satisfied with the application, they can use the mAR-Quran application to assist their memorization. This application able to provide the students centred learning by replacing the traditional learning environment with a new independent learning environment. Moreover, the application also can assist in the knowledge retention to enable the users to memorize the verses of surah in the Al-Quran which enable them to arrange the verses of the surah in the correct sequence.

3.3. Phase III – Testing & Evaluation

In this phases, Heuristic evaluation and user testing will be carried out, the evaluation of the experts are notified and be improve for end user testing. The user performance and capability are observe and evaluate in order to get the result.

4. Conclusion

The revolution of industry has impact the education sector to get along with the technology and has bring a great innovation experience to enhance the students learning and pedagogical method. The learning method of traditional Islamic education is needed to change by embedding new technology to motivate the students and enhanced students
learning experience. AR technology is a new dimension of technology that will bring benefit to the students especially to HI students. The operational framework is develop to ensure that process of the application development are run smoothly and provides guideline to the researcher while developing the apps. Moreover, this methodological approach can also be applied for educational project and future research project. During the analysis phases, an attributes or criteria for developing an application for HI students were identify to develop an application that are user friendly to HI students. Eventually, it can aid in memorization of Al-Quran among hearing impaired students.

Acknowledgments

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5. References

5.1. Journal Article


5.2. Conference Proceedings


