ARWeld: Augmented Reality Mobile Learning Apps for Welding Technology

Elli Amirah Binti Azlan and Muhammad Khair Noordin

Abstract--- The development of computer technology and multimedia software has make a lot of changes in the education world. Therefore, an application based on augmented reality technology that has been developed for welding technology students, which is related to the topic of welding joints. The development of the ARWeld application was developed as an initiative to make easier for teaching and learning process for teachers and students. This ARWeld application was developed using by AutoCAD 2017 and Unity 3D software as the main platform. Various types of graphic elements were combined in this application a such as text, animation, and 3D images. The main objective of this research is to design and develop a mobile application that uses augmented reality technology for welding technology. Prototype Model has been used as a guideline in the making of ARWeld application. It is hoped that this ARWeld mobile application will help welding technology students to make their learning process become more easily and effectively.

Keywords--- Mobile Application, Augmented Reality, Learning, Welding.

I. INTRODUCTION

The growth of technology makes a huge impact of education system in Malaysia. A various type of innovation in teaching aids that develop to make easier of teaching and learning process. Teaching aids is play an important role in the process of teacher teaching and student learning to ensure that the teaching process works smoothly and the content can be well followed by students. Teaching aids also can solve a variety of teaching methods that are constantly changing over time. However, the traditional learning still exists which is make student become passive during teaching and learning process. The processes of teaching and learning more to the traditional method it is not give positive effected [1]. In order for students to be actively engaged in the classroom, the use of technology appropriate can make the learning process become interesting. This is because students think the use of technology in classroom become more interesting. The learning and teaching environment becomes more interactive, creative and engaging when using new teaching methods [3].
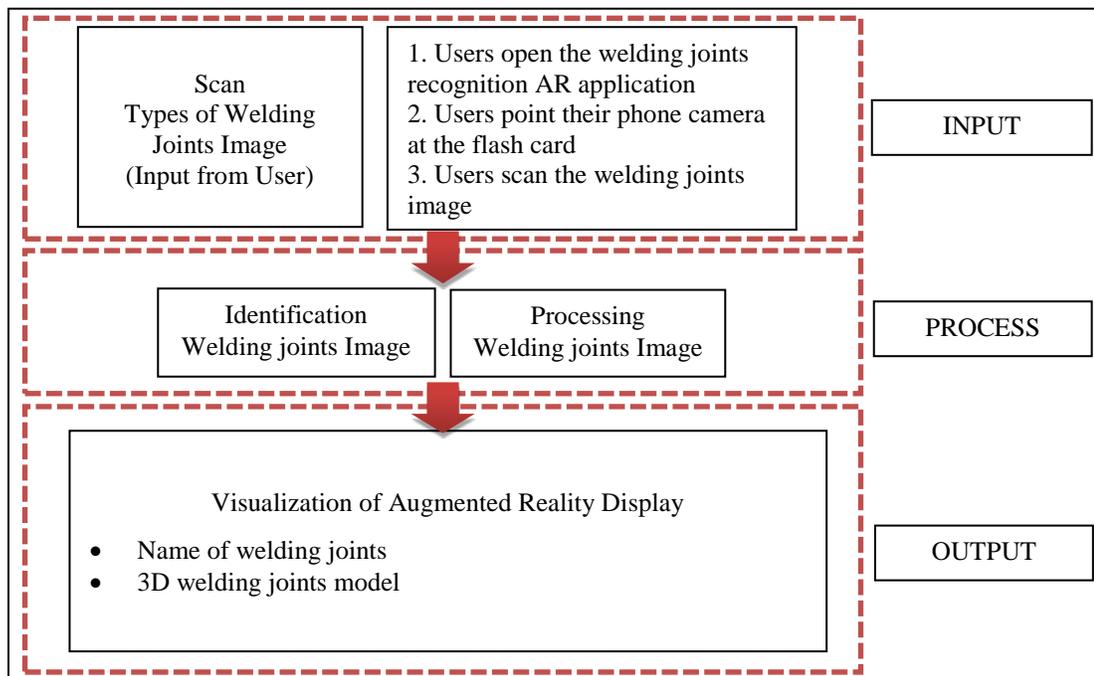
Nowadays many types of learning approaches that use in schools such as newspapers, television, and internet, but used mobile learning application as a learning approach is still not very popular in the Malaysian education system (5). Using mobile technology learning in augmented reality teaching can help improve students' skills in understanding and visualization more easily and effectively. Using multimedia and visual teaching aids during the teaching and learning process can enhance a student's understanding [2]. The use of AR technology in learning can increase the students' level of motivation through real learning experiences [6]. Mobile applications such as smartphones can have used anytime and anywhere compared to text books because they are small and wireless [7]. In addition, android mobile applications that utilize augmented reality technology in the field of welding technology

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skills in the education system in Malaysia have not yet existed. Most of the existing applications that have been developed on Google Play store and App store do not follow the syllabus of Kurikulum Standard Kolej Vokasional (KSKV) but are based on abroad syllabus or too general to be used as an addition tool to the learning process in schools. This paper present to design and develop teaching aids using android augmented reality mobile learning application for teacher that teach topic welding joint and student welding technology. Target groups for the development of this application are teacher welding technology and student year 1 in course welding technology at vocational college. The navigation interface in this application are used the Malay language as the medium of instruction. The mobile application of ARWeld that allows students to view a 3D model of welding joints. Furthermore, technology augmented reality will create unique environment because combination of two worlds with real world and virtual world [4]. Augmented reality also have a huge potential to enhance and improved of students' visualization skill. Besides that, using technology augmented reality as a teaching aids can support student learning and enhance their skills compared using conventional methods like text book. Using text books as learning approach don't give positive effect on student learning outcomes and made student become bored during teaching and learning process [8]. ARweld is an android mobile application that combines animated, text, visual and colour elements that can attractive student interest and enhance student memory. These visual teaching aids can strengthen concrete experiences, motivate students and increase student learning potential.

II.   FRAMEWORK DESIGN OF DEVELOPED APPLICATION

Table 1: Framework Design of Developed Application

Scan Types of Welding Joints Image (Input from User)	1. Users open the welding joints recognition AR application 2. Users point their phone camera at the flash card 3. Users scan the welding joints image	INPUT
Identification Welding joints Image	Processing Welding joints Image	PROCESS
Visualization of Augmented Reality Display • Name of welding joints • 3D welding joints model		OUTPUT

At the input phase, as we know, most of the augmented reality system scans images of reality in order to augment it. Thus, this can be done by using cameras or videos. For this research, smartphone with camera is use. User will use the Smartphone camera to scan the type of welding joints. First, users open the welding joints

recognition application using their phone. Next, users point the camera to the flash card of welding joints. Finally, users scan the image of the welding joints to be process.

Scene identification is one of the processes in process phase. The Augmented Reality for welding joints recognition is using the marker-based to make scene identification. The image of the welding joints that scan by the user during input phase will be the visual tags included in the real scene that can be recognized by the augmented reality. Processing fish image is beginning when the image of the welding joints is scan and identified. This process superimposes digital information onto the real scene. The welding joints image is scan and the system application will find the match image of welding joints and wait to show the type of welding joints information in the real word.

Visualization of the welding joints information is belonging to the output phase. This is the final phase for the welding joints recognition application. After the processing of welding joints image and the welding joints image match with the image from the system, the type of welding joints information will be display augmented. Finally, the system will show the visual type of welding joints information such as the welding joints name and 3D model on the mobile screen.

III.   THE DEVELOPMENT OF ARWELD

ARWeld is a mobile learning application that is developed specially for topic types of welding joint for student of welding technology. ARWeld application was developed using by AutoCAD 2017, Unity 3D, Vuforia, Android Studio and Java software as the main platform. This application just can have used only at android platform. Development of ARWeld is to innovation of teaching and learning tools that can help and improved visualization skills student. In addition, this application will also change style of teaching and learning approach in Malaysia. ARWeld used marker-based method to identify image of welding joints. The flash card that build from Marker-based method is used as a target image f when scanned it using the ARWeld apps. Figure 1 shows the picture of flash card ARWeld marker.
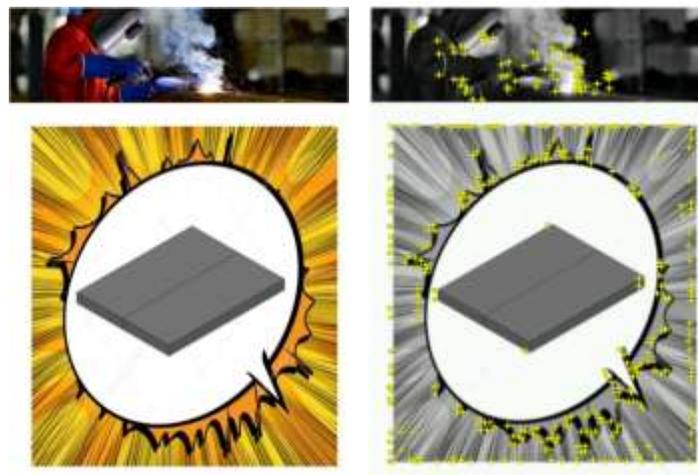

Figure 1: Marker-based ARWeld

(a)

(b)

(c)

Figure 2 (a): Main Interface of ARWeld, (b) Tutorial Interface of ARWeld, (c) Augmented Reality Interface

One of the essential features that must be emphasized in the development of this application it is application interfaces. This is because the main interface is make users become attractive to continue using this application. At

figure 2 shows the interfaces that have been design are main interface, tutorial interface, and Augmented Reality interface. This interface was being developed by using Unity 3D. All the graphical assets such as images and buttons was designed and edited using Adobe Photoshop software and has been formatted use Portable Network Graphic (PNG) because it has a transparent background. At the main interface have three button which is mula (Start) button, tutorial button and the exit button. When users click the mula (Start) button they go to the augmented reality interface. At this interface user can view 3D image of welding joints using the camera smartphone. Besides that, when users click the tutorial button that shows the tutorial interface. At the tutorial interface users can know how to use this application. The exit button that use for close this application. The most important interface for this application is Augmented Reality interface. This is because it to achieve the objective of this research study which is to recognize the name and types of welding joints based on the image from the camera using Augmented Reality method.

Figure 3 shows the images of the 3D model welding joints that have been use for this application. have 5 types of welding joints that is butt joint, corner joint, lap joint, tee joint and edge joint. All of the images must be in the same size which is 600 x 600. It is to make the recognition process easier. This model of the basic 3D type of welding joint is drawn using AutoCAD 2017 software and then editing using Blender software.
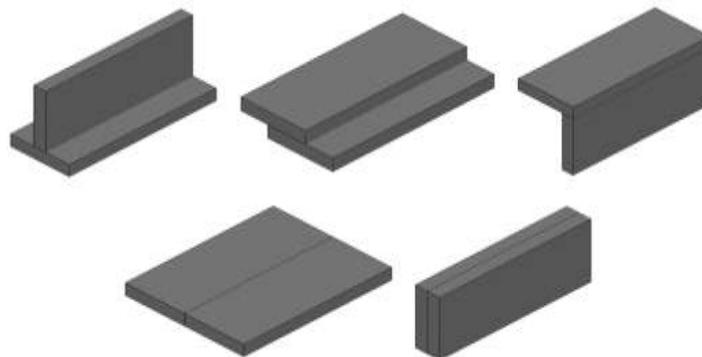

Figure 3: Image 3D Model Type of Welding Joints

IV.   METHODOLOGY

Mobile learning application ARWeld is developed to help teacher in teaching process and enhance visualization skill among welding technology students to make their more understand about the topic that they learn, that is type of welding joints. Besides that, this application also was developed to be a teaching aids that can change the style of teaching and learning.

The survey design was adopted in this study where data were taken using quantitative methods. Quantitative data will be obtained through the questionnaire form. The questionnaire was used as a research instrument containing a four-point Likert scale which was divided into four sections: part A on respondent information, part B on application functionality, part C on application interface, and part D on user satisfaction with this application.

Purposive sampling was chosen in this quantitative method because it has certain characteristics that are focused

by the researcher. This study involved a total of fifty respondents from teachers and student of welding technology vocational college. All the responded is an android user. Each responded need to respond a set of questionnaires to evaluated ARWeld application.

The questionnaire was conducted to test the functionality, interface and user satisfaction of the application. Before the evaluation, all the respondents were given a briefing how to handle this application.

The data collected will be analyzed using Statistical Package for Social Science software (SPSS) version 25 using descriptive statistics. The results of this quantitative data analysis are presented in a table showing the median and percentage.

V.   RESULTS AND DISCUSSIONS

The end result of this project is a mobile learning android application that combines the Augmented Reality technology with welding joint image recognition to make it more interesting and interactive. All the application features have been designed and developed successfully. The result fulfilled the objective of this project. Figure 4 shows the flowchart of the complete application.
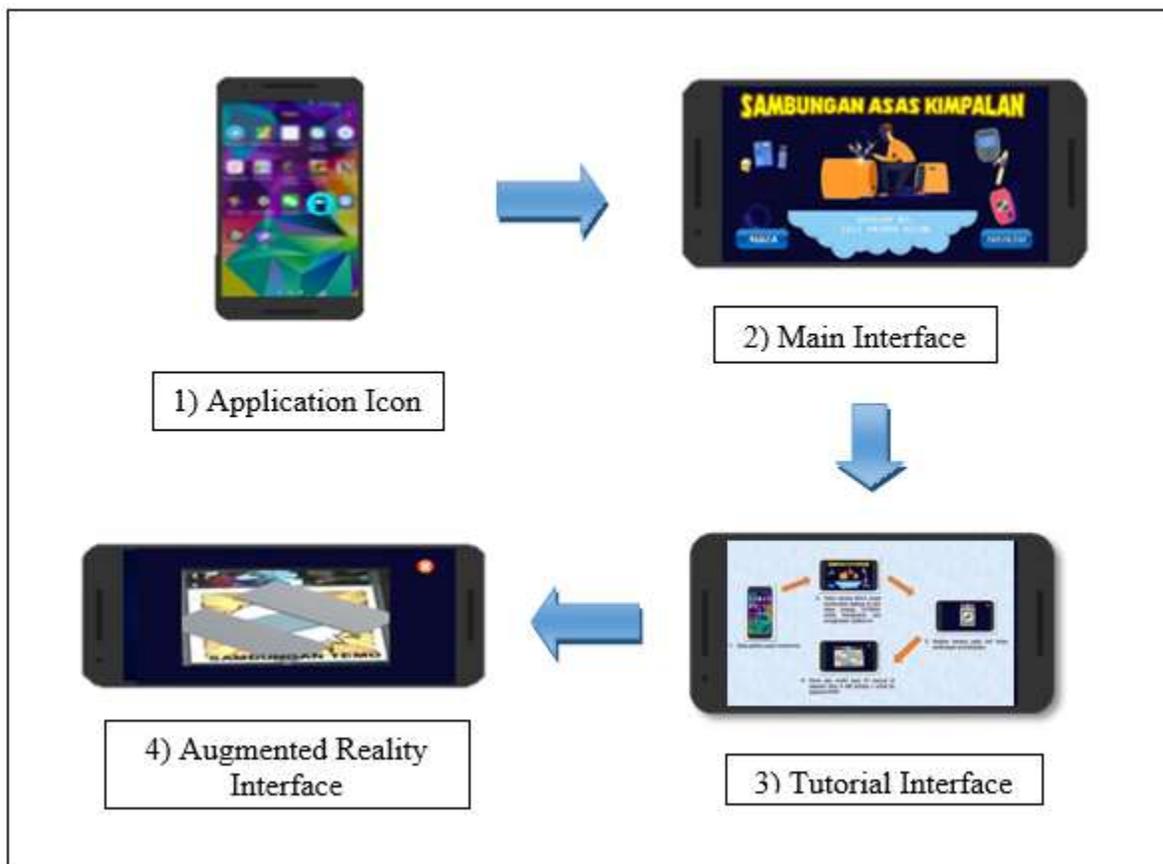

Figure 4: Flowchart of the Complete Application

After the welding joint recognition (AR) mobile application has been designed and developed, the user acceptance testing is conducted to test the application usability and collect the feedback from the user to improve the

application in the future. The user acceptance testing includes user evaluation on the application functionality, interface, and user satisfaction towards the overall application.

Result of Application User Acceptance Testing and Evaluation

In the ARWeld application, the user acceptance test is carried out to test the functionality, interface and user satisfaction towards the application. Fifty respondents are selected from welding vocational college teacher and student to test the ARWeld application. In the end of testing, they are required to fill the questionnaire to evaluate the application. Comments and feedbacks also are collected from questionnaire. The results of this study have been compiled and processed in a table format for easy reference. This median score is used because it is one of the methods used to analyze the questionnaire data after it has been collected. The median values applied are as shown in the table 2. Table 3, table 4 and table 5 shows evaluation result obtained in this study using in SPSS Version 2.5 to perform descriptive statistics.

Table 2: Criteria Analysis for Median Score by Numerical Scale

Score	Numerical scale	Interpretation
1.00-1.99	Strongly Disagree	Very Low
2.00-2.99	Disagree	Low
3.00-3.99	Agree	Medium
4.00 – 5.00	Strongly Agree	High

Table 3: Functionality of the Application

No	Attributes	Median	Median Interpretation
1	Interesting front page display.	5	High
2	The appropriate color of the display face.	4	High
3	The 3D images in the app are clear and easy to understand.	4.5	High
4	The text size is appropriate and easy to read.	4	High
5	The text colour used is appropriate.	3	Medium
6	The colour combination with used in the application is appropriate.	3	Medium
7	The animation used is interesting	5	High
8	The animation does not distract attention	4	High
9	This application displays sufficient information	2.5	Low
10	This application needs to contain exercise such as quiz	5	High
		4.0	

Table 3 shows the results of the functionality of the application evaluation analysis of the ARWeld application. From the table shown, item No. 9 had the lowest score of 2.5 (low) compared to the other items. The entire respondents stated that the application did not display sufficient information. Mobile apps were developed to help users to access information, content, and others to help them perform tasks more easily [13]. Therefore, all information and content related to the learning topics selected in this ARWeld application should be displayed. Items 5 and 6 were scored with a mean score of 3 where respondents disagreed with the size and colour of the text used in this application. According to [9] background colour and main background colour (graphics) should be different for clear vision. This indicates that the use of colour should be compatible with the design being developed.

In addition, in Items 1,2,3,4,7 and 8 in relation to the application display, 3D images, text size and animation received the highest score values (median = 4 to 5). The findings show that all users strongly agree with these

statements. However, with item 10 having a high score value of (median = 5), the findings indicate that users expect this application to provide an exercise like quiz. Online assessments can be made more effective and efficient as students can find out their scores faster [19]. Self-testing and quizzes or other activities such as games can enhance student mastery and students can learn based on their ability [20].

Overall, the descriptive analysis findings indicate that the average value median is at high score level 4.0 (Strongly agree). This high level of score results indicates that the functionality of ARWeld application that developed, meet need for teaching and learning process.

Table 4: Interface of the Application

No	Attributes	Median	Median Interpretation
1	The controls and buttons in the app are easy to understand.	4	Medium
2	The controls and buttons in the app work well.	4	High
3	Button design is interesting.	4	High
4	Browser recognition is easy to do.	4	High
5	The AR display is engaging and interactive.	5	High
6	Structured, clear, and attractive design	4	High
		4.0	

Table 4 shows the results of the interface of the application evaluation analysis of the ARWeld application. The AR display of this application is engaging and interactive received the high score (median = 5). Interactive multimedia materials with visuals, text, music, video and animation, were able to increase the students learning by 30% more than students using traditional learning methods [12].

Overall, the descriptive analysis findings indicate that the average value median is at high score level 4.0 (Strongly agree). This high level of score results indicates that the interface of ARWeld application has been works well and gets the user's attention

Table 5: User Stratification

No	Attributes	Median	Median Interpretation
1	This app is easy to operate.	5	High
2	The tutorial provided is easy to understand.	4	High
3	This application is very user friendly.	4	High
4	Links to other pages are easy to manage.	4	High
5	The language spoken is easy to understand	4	High
6	The use of buttons in the application is easy to control during learning	4	High
		4	

Table 5 shows the results of the user stratification evaluation analysis of the ARWeld application. Overall, the descriptive analysis findings indicate that the average value median is at high score level 4.0 (Strongly agree). This high level of score results indicates that the ARWeld application has been successful in satisfying its users.

This study found that users are very satisfied with the ARWeld application because this app is very user friendly. This result proves that the ARWeld application has given positive impact to users while using this app. This shows through the study of [10], user enjoy while using an application that has good usability features. Besides that, this app is easy to operate because choosing the right elements and avoiding complex use can make an application easier to use [10].

Overall, from all the result that is prove the mobile learning apps ARWeld is a good application as a teaching aids because this app can become more attractive to users especially for student. thus, from this app they can better understand what they are learned during teaching and learning process in class. Furthermore, the teaching style and teaching process become new and easier when visual animation and multimedia technology adds on. Learning through visual animations can create a fun learning environment for students and make an effective impact in attracting students, while making the learning environment more attractive and vibrant [12].

VI.   CONCLUSION

The application of ARWeld in the development of teaching aids to recognize type of welding joints is one of the turning points of the revolution in educational world. The development of this app facilitates teacher teaching and student learning in remembering types of welding joints effectively as it uses 3D animated image displays, text sizes and combination of colors that are appropriate and easy to read. The combination of colors and animation that used in understanding recognizing the type of welding joints can attract and help students to increase their visualization skill for give positive impact on their learning outcomes. Through a survey questionnaire that respondents have distributed and answered, the mobile learning application ARWeld it is the development of teaching aids make the teaching and learning process become easier because all the functionality in this apps easy to handle, the interface works well, user friendly and easy to operate.

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