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Implementation of Augmented Reality Technology for Basic First Aid Mobile Application

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Abstract: Augmented Reality (AR) is widely applied in many fields including first aid training in foreign countries. However, Malaysian have relatively low awareness of first aid due to a lack of first-aid training and a difficult-to-understand static first-aid manual. These concerns prompted the creation of AR-First Aid, a first-aid-related mobile application. The AR technology implemented enables users to learn first aid kit items and skills in AR. AR-First Aid also includes a mock first aid exam and each state's hospital list taken from the Ministry of Health's website. Then, the Technology Acceptance Model (TAM) is utilized for the user acceptance testing of 30 secondary school students. The observation shows that only 4.3% of the respondents cannot access the AR features while the remaining 95.7% give positive feedback on the application. Hence, the main future improvement is to develop the application with the AR function that can be supported by more devices.

Keywords: Augmented Reality, First Aid, Mobile Application

1.   Introduction

The public understanding of the importance of basic first aid skills is reported to be so low that the ratio is 1:10 in Malaysia [1]. The research done reported that only 67 out of 375 secondary school students experienced first aid learning in Kuantan [2]. Moreover, first aid is taught once a week in a co-curricular class by using the conventional teaching method such as the physical demonstration in school. Then, the first aid guidebook provided by the first aid manual is in static form with only text and images which is not of interest to users. In addition, most of the first aid applications available on the Google Play Store only offer learning modules and lack engaging features such as Augmented Reality (AR), exercises and simple games. Besides, the Industrial Revolution 4.0 (IR 4.0) which affects the transformation and digitalization of the education sector has driven the idea to develop the application by incorporating the use of AR. Thus, the purpose of this paper is to propose a basic first aid application namely AR-First Aid with AR technology. The objectives of the project are to design an AR-First Aid using material design principles; to develop a platform that enables users to learn first aid by

implementing augmented reality from objective 1, and to perform functional testing and user acceptance test on the developed application to the target user.

AR-First Aid is designed and developed in English for teenagers from 13 to 17 years old. It is developed for the Android platform. The application's design incorporates the hues blue, red and white, which are typically seen in hospitals. The application consists of 5 modules which are AR-first aid kit, skills, emergency service, Covid-19 Advice and the exercise and game module. The Subject Matter Expert (SME) of this project is an ex-area superintendent of St. John Ambulance in Pontian, named Teo Cheng Chuan. The St. John Ambulance website in the United Kingdom [3] and the first aid guidebook produced by St. John Ambulance Malaysia [4] are used as references to ensure the reliability and accuracy of the information in the application. Additionally, the material design introduced by Google is also applied in the development of AR-First Aid.

3 sets of 10 random multiple-choice exercises are designed in the exercise module. Each of the questions will have four interactive buttons that represent four different choices. The correct answer will be shown to users via a pop-up message. Last, a drop-and-catch game is designed in the game module. The score is recorded and displayed in the upper left corner of the screen. In short, the application can benefit teenagers in secondary school and increase their awareness of first aid. The application can also act as a self-learning material for those who do not have experience in first aid.

The rest of the paper is organized as follows: Section 2 discusses the literature review of the related work and the existing application. Section 3 presents the methodology used in the application development. Besides that, Section 3 includes a discussion of the analysis and design process of the application. Section 4 includes the results and discussion and Section 5 reveal the conclusion of the project.

## 2.	Related Work

This section discusses the domain study of the project, the technology used and also the comparison between the reviewed applications and the proposed application.

### 2.1	First Aid

First aid is initial assistance based on the principle of practical medicine and surgery that can be applied to a casualty or patient before the professional medical team arrived [5]. In Malaysia, the first-aid-related associations have their cadet divisions attached to the secondary schools. The students will participate in either one of these first aid clubs in the school as their co-curriculum class. This is due to the announcement of the Education (National Curriculum) Regulation 1997 which makes student involvement in co-curricular activities become a must [6]. While the traditional method used in teaching first aid is through face-to-face training by trainers. Students will be given advice and correction from the trainer when they perform the first aid skill wrongly. However, the existing method will cause inconvenience to the students during the Covid-19 endemic as some parents decide not to send their children back to school since they thought it is difficult to ensure the following of the Covid-19 standard operating system in school [7]. Thus, the students are not able to learn the first aid using the traditional method. Hence, it gives prominence to the importance of implementing AR technology in the first aid mobile application. The details of the AR in mobile applications will be discussed in Section 2.2.

### 2.2	AR in Mobile Applications

Augmented Reality (AR) is a technology that enables people to see virtual elements such as audio, video, graphics and Global Positioning System (GPS) position information in the actual environment [8]. There are two types of AR technology that are marker-less AR and marker-based AR. Marker-based AR is an AR technology that requires a 2D image as a marker for the device to scan [9]. The virtual 3D model will appear to overlay the AR marker after the target image is being scanned. The

strength of marker-based AR is it has a higher position accuracy compared to marker-less AR. This is because the virtual 3D model will be presented laying over the specific marker. Besides, marker-less AR is a type of AR technology that can function without a target image. It functions depending on the GPS technology as it will read the location of the 3D model that has specific longitude and latitude value [9]. Since the quality of marker-less AR is not affected by the AR marker, it is more stable [10]. The examples of marker-based and marker-less AR are shown in Figure 1(a) and Figure 1(b).

Figure 1(a): Marker-based AR [10]　　　**Figure 1(b): Marker-based AR**

Besides AR, mobile technology is a type of technology that allows humans to access information and each other from anywhere and at any time as long as Internet access is available [11]. It is now being widely used especially in the education field where students are using their mobiles to submit their school assignments, record class lectures and so on [12]. The integration of mobile operating systems such as Android and IOS allow the users to use the mobile phone as a computer [13]. Hence, Android technology is used for application development since it is free and open source.

Furthermore, material design is a design concept introduced by Google which is evolved from Android design [14]. Inside the material design concept, there are several sections, such as design and components, that will be used as a guide in designing the user interface for the application [15]. The material components include the buttons, navigation bar and sliders. It allows the application to have a better look. The users will be adapted to the use of the application more quickly when the material design guideline is utilized in the design of the application [16].

In short, three technologies which are AR technology, mobile technology and material design are applied in the proposed application. Since there are many first aid applications in the market, the applications are reviewed and compared in the next sub-section.

2.3　　　Comparison Between Reviewed Applications and Proposed Application

This section will describe the differences between the reviewed applications and the proposed application. 3 applications that are First Aid Study [17], First Aid [18] and Instant Aid-First Aid App [19] have been reviewed. 6 features of the application such as AR, involvement of first aid kit module, gamification and extensive exercise, the operating system supported and the cost required were compared as tabulated in Table 1. Figure 2 shows the user interface of the reviewed applications.
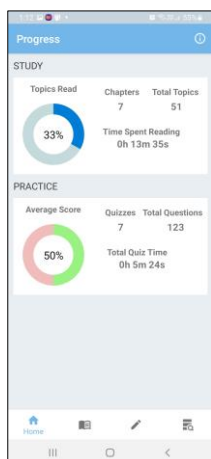
Figure 2(a): First Aid Study [17]
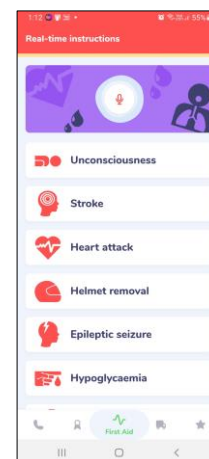
Figure 2(b): First Aid [18]

Figure 2(c): Instant Aid – First Aid App [19]

Based on Table 1, the first gap to be discussed is the existing applications do not provide AR but the proposed application doses have. Secondly, the proposed application provides the first aid kit module which is not provided in the two reviewed applications. Furthermore, the existing applications do not provide gamification to users. The simple drop and catch game and extensive exercise are implemented in the proposed application to engage the users with it. Additionally, AR-First Aid required a higher Android version to support its AR feature compared to the reviewed applications. Lastly, the free-of-charge feature is applicable for all the applications except for Instant Aid.

Table 1: Comparison between the reviewed applications and proposed application

Application Features	First Aid Study	First Aid	Instant Aid	AR-First Aid
Augmented Reality (AR)	Do not provide AR features to the users.			Provide marker-based AR features to the user.
First aid kit learning module	Does not provide a first aid kit module.	Provide first aid kit module in text form.	Does not provide a first aid kit module.	Provide first aid kit module in AR form.
Gamification	Do not provide the game to the users.			Provide drop and catch game to the user.
Extensive exercise	Provide 7 sets of exercise questions to the users.	Does not provide exercise to the users.	Provide quiz but need payment before the user can access the quiz.	Provide 3 sets of random 10 exercise questions to the users.
Operating System	Support Android version 6.0 and above.	Support Android version 5.0 and above.	Support Android version 5.0 and above.	Support Android version 7.0 and above.
Payment charges	Free of charge.	Free of charge.	Partially free of charge.	Free of charge.

3.   Methodology

The Multimedia Mobile Content Development (MMCD) [20] methodology utilized in developing AR-First Aid will be discussed in this section. MMCD is selected because it is more focused on the content navigation and the object used in the project. The five phases of MMCD that will be discussed are application idea creation, analyze the structure, design of the process, develop the main function and testing. Figure 3(a) and Figure 3(b) show the original and the adapted MMCD diagram where the stage to update the structure in phase 2 has been removed as the project is not planned to update the structure after it has been finalized in phase 1. Then, the sub-sections of Section 3 will discuss each phase of MMCD methodology in detail.
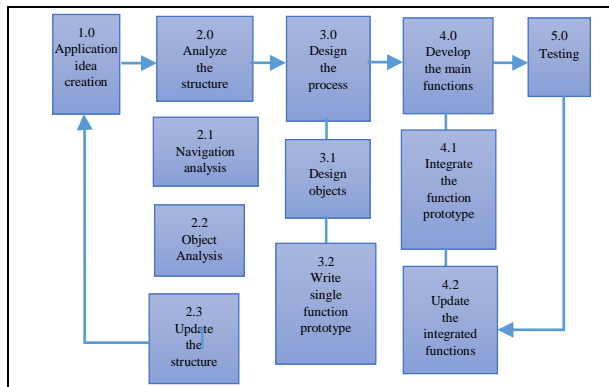
Figure 3(a): Original MMCD Diagram [20]	Figure 3(b): Adapted MMCD Diagram
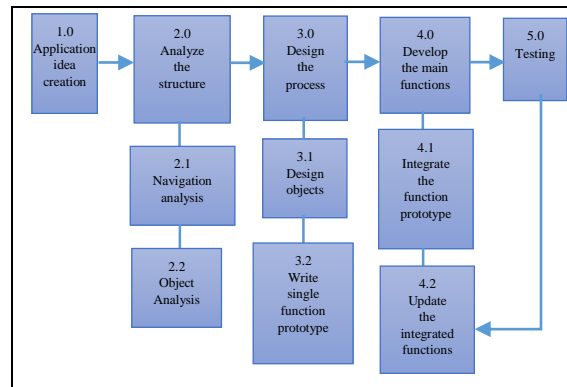
3.1   Application Idea Creation

Application idea creation is the first phase of the MMCD methodology. Table 2 tabulates the information required to prepare for the upcoming design and development process. Besides, the user analysis was done based on the results of the questionnaire and interview. 30 respondents responded to the questionnaire and all of the respondents were 13 to 17 years old. From the data collected, almost 50% of the respondents have a first aid kit at home and have experience learning the items of the first aid kit. Then, cardiopulmonary resuscitation (CPR) and choking were recorded as the top skills taught in the school. However, the data reveal that AR has yet to be implemented as a teaching tool in the school. Also, the study showed that a noisy teaching environment is the biggest weakness of learning first aid face-to-face. Meanwhile, almost 73% of the respondents agreed that the implementation of AR will increase their interest. Table 3 shows the information gathered from the user analysis. The statistic is then attached as Figure 13(a), Figure 13(b) and Figure 14 in Appendix A.

Table 2: Checklist of Application Idea Creation Phase

Item	Note
Type of application	Mobile application.
Target device	Android Smartphone.
Target users	Teenagers from age 13 to 17 years old.
Graphic User Interface	Main Interface, main menu, first aid kit module menu, Augmented Reality interface, first aid skill module, emergency service module, Covid-19 advice module and the exercise and game module.
3D models	10 3D models of Augmented Reality.
Images	Images will be used in icons, navigation buttons and the background of the application.
Video	3D animation created for the choking, nosebleeds and CPR first aid skills.
Audio	The sound effect for the game module.

Table 2: (cont).

Item	Note
Application synopsis	AR-First Aid is a mobile application that introduces knowledge about first aid kits and skills to teenagers. The application provides 10 3D first aid kit item models for the first aid AR module. It also provides the users with animation videos related to first aid skills. The application is designed with images that correspond to the exercise questions in the exercise module. The audio is used when the user catches the first aid kit item in the game.

Table 3: User Analysis

Stakeholder Category	Role in product	Design implications	Action needed
Subject Matter Expertise (SME)	Content consultant expert in first aid	Based on the interview, content design	• The exercise questions can be referred to the famous first aid organization. • Emergency number 112 should be removed from the content designed. • Three main skills, CPR, choking and nosebleed that are commonly taught in school should be included in the application.
		Simpler user interface design	• Besides the text, images and video can be used. • All navigation buttons should have the same size.
General User (Teenagers from 13 to 17 years old)	End-user of the application	Based on the questionnaire, User preferences	• The animation should be used in application development. • Augmented reality (AR) should be implemented in the application.

3.2 Analyze the Structure

Analyzing the structure is the second phase of the MMCD methodology. The phase's two main activities are to analyze the navigation as in Table 4 and the objects. Then, the navigation structure of the application is displayed in Figure 4(a).

Table 4: Content Structure Checklist

Item	Note	Item	Note
Layer design	Layer 3: C# Script in Unity Layer 2: Content Layer 1: Background images	Menu and Navigation	Navigation: • Start button • Information buttons • Close buttons • Play and play again button Menu: • Labelled button for modules Bottom navigation bar
Frame design	Frame 1: Main interface Frame 2: AR marker scanning scene Frame 3: First aid kit module Frame 4: Skills module Frame 5: Emergency service module Frame 6: Covid-19 advice module Frame 7: Exercise and game module Frame 8: Exercise questions Frame 9: Game		
Number of main GUI	Logo of the application	Sub GUI	None

Then, the storyboard as in Appendix A, the system flowchart and the functional and non-functional requirement analysis is also included in this phase. The two requirements' analyses are tabulated in

Table 5 and Table 6. While the overall system flowchart is shown in Figure 4(b) and the flowchart for the Covid-19 module and Exercise and Game module is attached in Appendix A.
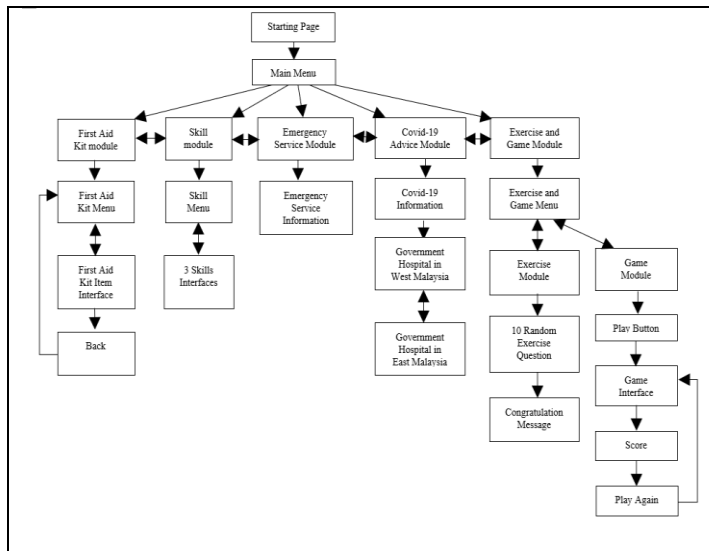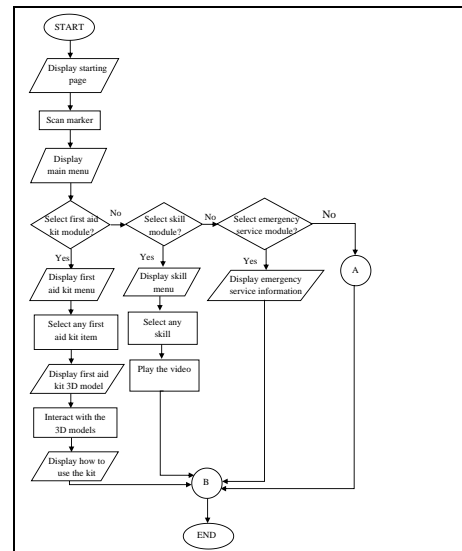

Figure 4(a): Navigation structure   **Figure 4(b): Overall system flowchart**

Table 5: Functional Requirements

Functional Requirements	Module	Description
User Interaction	First aid kit module	• The system shall provide users with the ability to choose the items and rotate the item in its 3D view. • The system shall provide users with the ability to display the selected first aid kit item information.
	Skill module	• The system shall provide users with the ability to choose the skills. • The system shall provide users with the ability to play video.
	Emergency Service and Covid-19 Advice module	• The system shall provide users with the ability to view related information. • The system shall provide users with the ability to see the list of government hospitals in their states through the Covid-19 advice module.
	Exercise and Game module	• The system shall provide users with the ability to play the game. • The system shall provide users with the ability to swipe the game character. • The system shall provide users with the ability to play the game again.
Autonomous System Activities	First aid kit module	• The system shall ask the new users for their camera permission. • The system shall display the 3D AR model selected by the users.
Autonomous System Activities	Exercise and game module	• The system shall display the correct answer to the users when they choose the wrong answer. • The system shall display the alert message when the users finish answering all exercise questions.

Table 5: (cont).

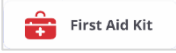| Functional Requirements	Module	Description
Autonomous System Activities	Exercise and game module	• The system shall deduct the lives automatically when the users catch the bomb. • The system shall calculate the score for the gameplay.
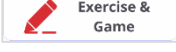
Table 6: Non-functional Requirements

Non-functional Requirements	Description
Performance	• The application shall operate online to get the marker from Google Drive. • Any interactions between the user and the system and the time to display 3D models should not exceed two seconds.
Operational	• The application shall be able to operate on any android device with Android version 7 and above.
Cultural	• The application shall be developed in English.

3.3   Design the Process

The two main activities in this phase are to design the objects and write a single function prototype. All of the objects designed by using different tools such as Adobe Photoshop and Blender are imported into Unity to produce the prototype. Unity compiles the imported assets and integrates them with specific scripting to enable them to function. The button designs are presented in Table 7. After the objects are designed, it proceeds to the phase of develop the main functions.
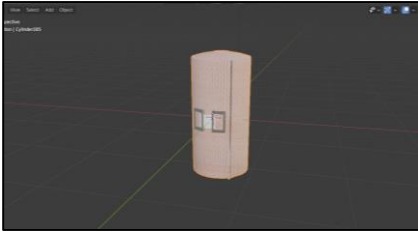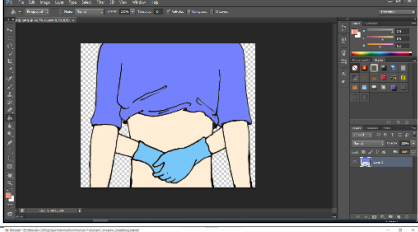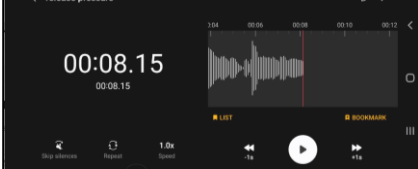
Table 7: Button Design

Button	Description	Button	Description
	Start button		Close button
	First aid kit module button		Play button
	Skills module button		Play again button
	Emergency service module button		Emergency service module button
	Covid-19 advice module button		Covid-19 advice module button
	Exercise and game module button		Exercise and game module button
	First aid kit module button		Info button
	Skills module button		Instruction button

3.4   Develop Main Functions

This phase is focusing on the integration of the function prototype. Each of the prototypes is integrated with the C Sharp scripting to allow them to function. However, the assets have to be developed before they can be integrated with the script. This sub-section discusses the application asset implementation and the integration in Unity with scripting. Table 8 shows the application asset implementation.

Table 8: Application asset implementation

Assets	Development	Description
3D models of first aid kit		The 3D models of the first aid kit are modelled and textured in Blender. There are 10 3D models for the first aid kit items. Each of the models is imported to Unity to be integrated with the AR function.
3D models of characters		There are 2 3D characters developed in Blender. The characters are rigged and animated in Blender before the animation clips are imported and used in Unity.
2D images		All 2D assets are first hand-drawn before they are redrawn in Adobe Photoshop. The 2D assets include the game characters, the pictures for the tips and mock exam questions and the buttons for each state of Malaysia.
3D animations		There are 3 3D animations created for the skills module of AR-First Aid. The animations are first developed in Blender and then imported into Unity.
Audios		There are several audios recorded for the steps of using the first aid kits and the steps of performing the first aid skills in the 3D animations.

Once the assets are implemented, the prototype is integrated with the scripts in Unity. For example, PlayAnimAudio.cs script is used to play animation audio clips in sequence as shown in Figure 5.

```
public class PlayAnimAudio : MonoBehaviour {
   private AudioSource audioSource;
   public AudioClip[] audioForAnim;
    void Start() {
      audioSource = GetComponent<AudioSource>();
      StartCoroutine(PlayAudioSequentially());
    }
   IEnumerator PlayAudioSequentially()
   {
      yield return null;
      for (int i = 0; i < audioForAnim.Length; i++) {
         audioSource.clip = audioForAnim[i];
         audioSource.Play();
         while (audioSource.isPlaying) {
            yield return null;
         }
      }
   }
}
```

Figure 5: C Sharp script for playing the animation audio

The main function to play the audio for the animation is written in IEnumerator() function. The 'yield return null' allows the audio clips to be played one after another. While the for loop indicates that the audio clips will be played using the Play() function in sequence. Besides the PlayAnimAudio.cs, QuizManager.cs is created to manage the mock first aid exam question in the Test Yourself module. Figure 6(a), Figure 6(b) and Figure 7 show the code segments of QuizManager.cs.

```
void GenerateQuestion()
{
    if(QnA.Count > 0) {
        if(QnA.Count < 21) {
            Debug.Log("End of the question");
            GameOver();
        }
        currentQuestion = Random.Range(0, QnA.Count);

        questionText.text = QnA[currentQuestion].question;

        questionImage.sprite =
QnA[currentQuestion].questionImg;
        questNum++;
        questionNumber.text = questNum + "/" + "10";
        SetAnswer();
    }
    else {
        Debug.Log("Out of Question");
        GameOver();
    }

}
```

Figure 6(a): GenerateQuestion() function

```
void SetAnswer()
{
    for(int i=0; i<options.Length; i++) {
        options[i].GetComponent<Image>().color =
options[i].GetComponent<AnswerScript>().startColor;

        options[i].GetComponent<AnswerScript>().isCorrect =
false;

options[i].transform.GetChild(0).GetComponent<Text>().text =
QnA[currentQuestion].ans[i];

        if (QnA[currentQuestion].correctAns == i+1){
            options[i].GetComponent<AnswerScript>().isCorrect
= true;
        }
    }

}
```

Figure 6(b): SetAnswer() function

```
public void Correct() {
    score++;
    quizAudio.PlayOneShot(correctSound, 1.0f);
    QnA.RemoveAt(currentQuestion);
    StartCoroutine(WaitForNext());
}

public void Wrong() {
    quizAudio.PlayOneShot(wrongSound, 1.0f);
    correctAnswer.text =
QnA[currentQuestion].answerInString;
    incorrectPanel.SetActive(true);
    QnA.RemoveAt(currentQuestion);
}

IEnumerator WaitForNext() {
    yield return new WaitForSeconds(1);
    GenerateQuestion();

}
```

Figure 7: Correct() and Wrong() functions

QuizManager.cs consists of several functions to complete the function of the Test Yourself module. The GenerateQuestion() function applies Random.Range() to generate the questions randomly. It is coded to generate only 10 questions each time and the questions' image can change based on the question. Then, the SetAnswer() function in Figure 6(b) is called to set the correct answer for the question and also display each answer choice in the test. After that, the score in the test is set to increase by one when the user answers the question correctly. The correct answer is displayed in a pop-up panel if the user gives a wrong answer.

The other function used in the AR-First Aid application is the game score counting function. It is coded in the ScoreManager.cs. Figure 8 portrays the code segment for the ScoreManager.cs.

```
void Update()
  {
    scoreData.text = score.ToString();
    scoreInPause.text = scoreData.text;
    scoreInFinal.text = scoreData.text;
    highScoreText.text = highScore.ToString();

    if (score > highScore)
    {
      PlayerPrefs.SetInt("HighScore", score);
    }
}
```

```
void OnTriggerEnter2D(Collider2D target) {
    if(target.tag == "Covid") {
      Destroy(target.gameObject);
      lives--;
      if(lives < 1){
        Destroy(heart[0].gameObject);
        gameOverPanel.SetActive(true);
        Time.timeScale = 0;
      }
      else if(lives < 2) {
        Destroy(heart[1].gameObject);
      }
      else if(lives < 3) {
        Destroy(heart[2].gameObject);
      }
      playerAudio.PlayOneShot(bombSound, 1.0f);
    }
    else if(target.tag == "Kits"){
      Destroy(target.gameObject);
      score++;
      playerAudio.PlayOneShot(collectKits, 1.0f);
    }
}}
```

Figure 8(a): The code segment for high score calculating

Figure 8(b): The code segment for score and lives calculating

The score counting system in the drop and catch game consists of two parts which are updating the highest score and calculating the score obtained throughout the game. The Update() function is used to display the score and compare and update the highest score gained by the user. While the OnTriggerEnter2D() method is used to deduct the player's lives and increase the score when the player catches the kits.

Table 9 shows the interface of the completed application being developed. All functions are updated after performing each test and fixed the bugs if occur.
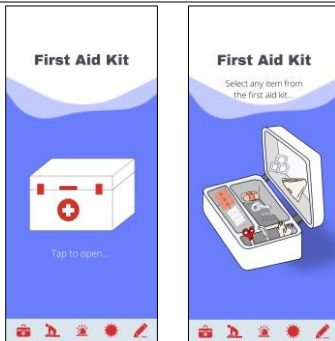
Table 9: Interface of the developed application

Module	Interface	Module	Interface
Starting Page and main menu of AR-First Aid		AR First Aid Kit Module	

Table 9: (cont).

Module	Interface	Module	Interface
Skills Module		Emergency Service Module and Covid-19 Advice Module	
Test Yourself Module		Game Module	

3.5   Testing

In the testing phase, all modules and features developed in the application will be tested to ensure they can work properly. Functional testing and user acceptance test are performed in this phase. Table 10 presents the results of the functional testing which is used to ensure the buttons function properly.

Table 10: Result of functional testing

Test	Expected Result	Actual Result	Correction
Start Button	Navigates to the main menu scene.	Works well as expected.	No correction is needed.
Marker Link	Navigates to the Google Drive that has the marker.	Works well as expected.	No correction is needed.
Buttons in Each Menu and Navigation Bar	Each button navigates to the correct scene.	Works well as expected.	No correction is needed.
Buttons in Navigation Bar	Each button navigates to the correct module.	Works well as expected.	No correction is needed.
Next and Back Button	Navigates to the next scene and the previous scene.	Need to press twice to go to the next scene.	Code the next button function in a new script.
Tips Button	Open the tips panel when pressed.	Works well as expected.	No correction is needed.
Replay Button	Replay the animation.	Works well as expected.	No correction is needed.
Map Buttons	Each button navigates to the Ministry of Health's website which shows the list of the government hospitals.	Works well as expected.	No correction is needed.
3D Model displayed in AR	The 3D models are displayed in AR on the screen.	Works well as expected.	No correction is needed.
Animation Audio	The audio can be played in sequence.	Works well as expected.	No correction is needed.

In addition, the user acceptance test is undergone physically in SMK Dato' Ali Haji Ahmad, Pontian (SMKDAHA). The questionnaire is developed by using Technology Acceptance Model (TAM) [21] to test the user acceptance level of the application. There are five aspects covered in the questionnaire which are demographic respondents, perceived usefulness (PU), perceived ease of use (PEOU), user satisfaction (US) and the attribute of usability (AU). The results of the user acceptance test are described in the results and discussion section.

4.   Results and Discussion

The testing is conducted physically on 30 respondents in SMKDAHA. The 5-point Likert scale is used in the questionnaire. The discussion on the result includes the four aspects of the TAM model. Figures 9, 10, 11 and 12 demonstrate the data for each variable of TAM. Figure 9 shows that there are 96.7% of respondents agree with the usefulness of AR-First Aid. Figure 10 reveals that more than 76.7% of respondents strongly agree that the application is easy to use. Meanwhile, Figure 11 highlights that more than 66.7% of respondents were satisfied with the design and use of AR-First Aid. Then, Figure 12 has obtained an average of 86.7% of respondents agree with the usability of AR-First Aid. The average value is obtained by summing up all agree and strongly agree values and then dividing it by four. As most of the respondents (93.3%) found that the AR technology is easy to use, the application can be concluded as having a high user acceptance level. However, there are an average of 4.3% of respondents hold an objection to the statements. This is because some of the respondents' devices are not supported by ARCore by Google. This issue leads the respondents unable to access the application's AR capabilities. Even though there are some negative responses, the number of positive is still much

higher than the negative ones with 4.3%. Thus, it can be summarized that the user has a high acceptance and satisfaction level with the application and the AR technology implemented.
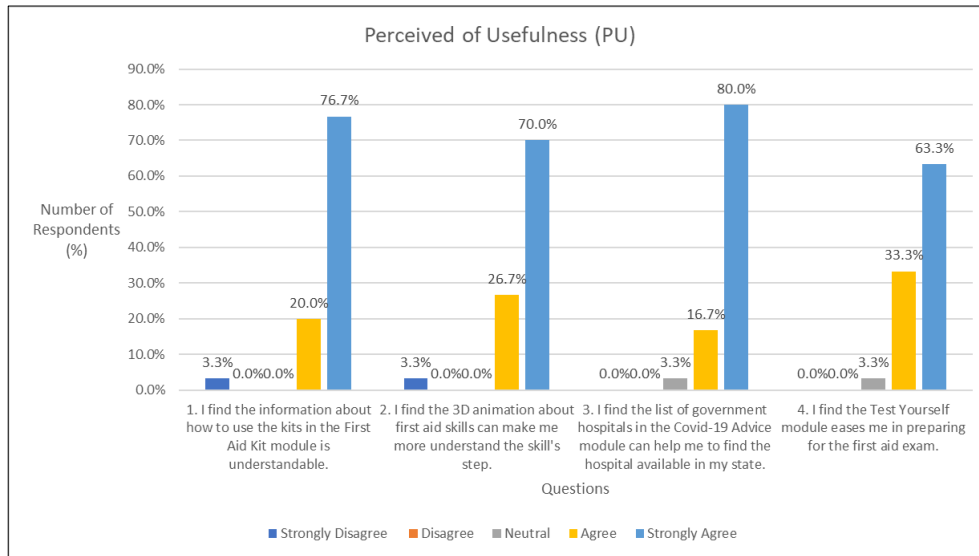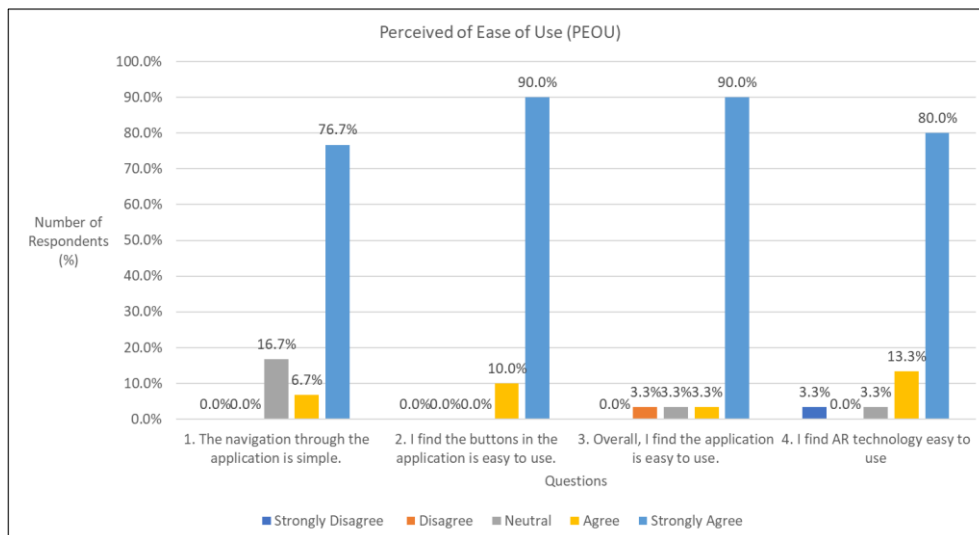

Figure 9: Perceived Usefulness (PU)

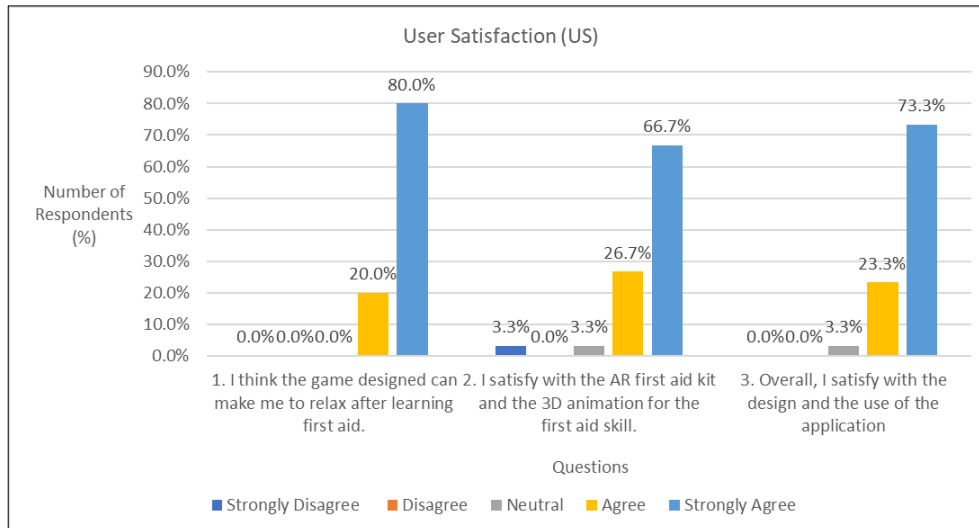**Figure 10: Perceived Ease of Use (PEOU)**
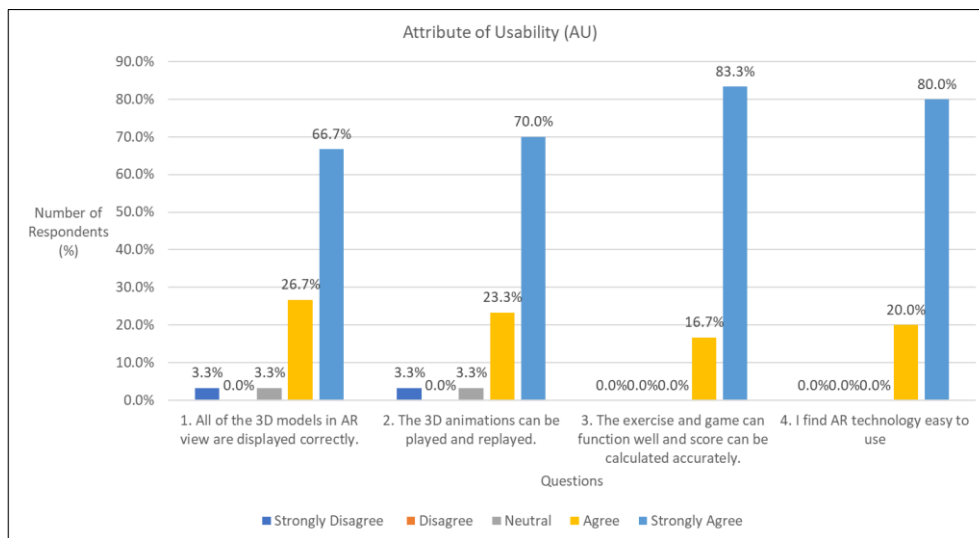
Figure 11: User Satisfaction (US)

Figure 12: Attribute of Usability (AU)

5.   Conclusion

The application has accomplished the project objectives which are to design an AR-First Aid using material design principles, develop a platform that allows users to learn first aid by implementing augmented reality from the first objective and conduct functional testing and user acceptance test on the developed application to the target user. The feedback from the user acceptance test concludes that the application is easy to be used for secondary school and can help them in learning first aid. There are few advantages that can be concluded from the test. First, the application provides the real first aid exam mock questions to assist the users who are preparing for the first aid exam. Second, AR-First Aid provides understandable information with AR technology that helps beginners to learn about the first aid kits and skills in an interactive manner. Besides that, AR-First Aid also offers a simple drop-and-catch casual game as an added value to enhance their understanding. It also provides a list of government hospitals in each state which helps the users to find the hospital available in their state. Moreover, the application also has a high user acceptance level as it has been proven the application is easy to use as there are more than 90% of the respondents agreed that the application is easy to use. However, there are several limitations to AR-First Aid such as the ARCore is not supported for all types of devices and the application can only contain either the zooming or the rotating function.

Acknowledgment

The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support in developing the proposed application.
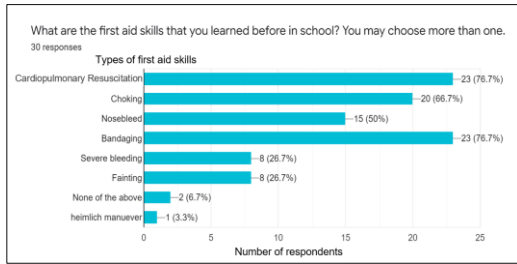
Appendix A
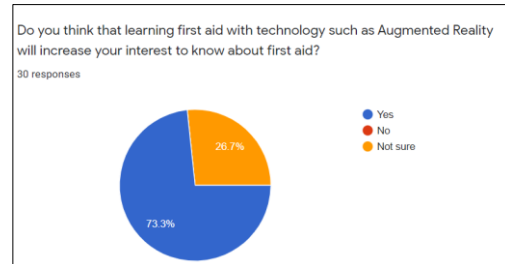

Figure 13(a): First aid skill learned in school

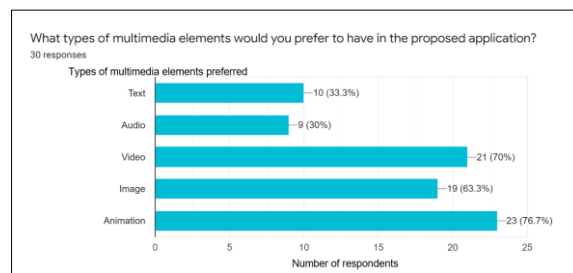**Figure 13(b): AR increase the interest to know first aid**

Figure 14: Types of multimedia elements preferred by the respondents
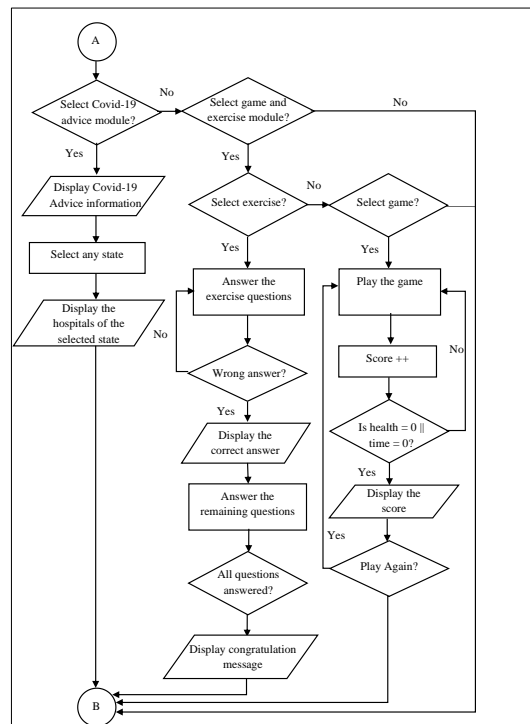

Figure 15: Flowchart of Covid-19 Advice module and Exercise and Game module

Table 11: Interface Design

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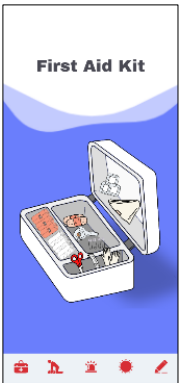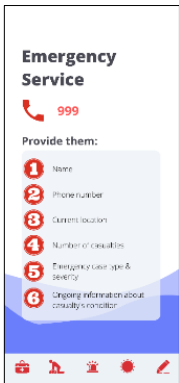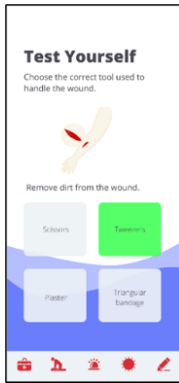
Interfaces	Description	Interfaces	Description
	On the starting page of AR-First Aid. The hyperlink is provided for the image to download the image. Users click on the next button to scan the marker and launch the application.		This is the main menu of AR-First Aid. The users can choose any button that represents the specific module from the main menu.

Table 11: (cont).

Interfaces	Description	Interfaces	Description
	The main menu of AR-First Aid. The users select an item in the First Aid Kit box to view the AR.		The interface of the emergency service module contains information needed during an emergency call.
	This is the interface of the exercise question. It will respond to the user based on the answer selected.		This is the interface representation for the skills contained in the Skills module. There will be a video animation provided for each skill.

These are the interfaces of the game module. The user clicks on Play to start the game. The gameplay contains the player, the props, score, lives and time recorded.

The Covid-19 advice module contains some advice during the Covid-19 endemic and a next button is provided to view the government hospitals in Malaysia.

The interface that shows the map of West Malaysia which will link to the official website of the Ministry of Health Malaysia contains a list of government hospitals.

The interface that shows the map of East Malaysia which will link to the official website of the Ministry of Health Malaysia contains a list of government hospitals.

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