Introduction Of Emergency Equipment For Floods, Fires And Riots In Augmented Reality

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Abstract.
Indonesia is one of the countries with a high risk of natural disasters in several regions. Emergencies can result in death or property destruction. While dealing with catastrophes, swift action and anticipation are required; yet, if the community is unfamiliar with emergency equipment, it will take longer to overcome emergencies. It turns out that many people still do not understand emergency equipment information correctly. The active engagement of the community in recognizing emergency equipment can be enhanced by the provision of information. The implementation of an application utilizing Augmented Reality technology and the Fisher Yates Shuffle algorithm aims to enhance public awareness and promote active engagement in identifying emergency equipment. Once the application has been developed and constructed, the evaluation process will involve the utilization of a pre-test, post-test, and the N-Gain Score methodology. The N-Gain Score is a valuable tool for gauging the extent of the community's comprehension in identifying emergency equipment. Additionally, a Questionnaire will be employed to evaluate the level of user satisfaction with the application. The findings of the study revealed that the level of knowledge acquired by users, as assessed, was 57%. This suggests that users demonstrate a relatively high level of proficiency in understanding emergency equipment when utilizing the application. Furthermore, the overall satisfaction of users with the program received a final score of 86%, showing a high degree of effectiveness.

Keywords: *Augmented Reality, Emergency Equipment, Fisher Yates Shuffle, Introduction Application, and Marker Based Tracking.*

I. INTRODUCTION

Indonesia is listed as one of the 180 nations with the highest risk of disaster in The Global Risk Index for 2019 [1]. From 2019, which recorded 3,814 disaster events, through 2020, which recorded 4,650 disaster events, to 2021, which recorded 5,402 disaster events, floods is the most prevalent catastrophe event and also has the highest number of disaster events [2]. In addition, there were 17,768 fire occurrences in Indonesia in 2021. In addition to fires, non-fire occurrences are also prevalent in Indonesia. However, non-fire rescues were reported 79,559 times, meaning that the frequency of non-fire rescues was nearly five times higher than that of rescues related to fires [3]. Based on this data, the active role of the entire community in helping to overcome fire and non-fire incidents can reduce the occurrence of higher risks. Because the issue cannot be resolved if you solely rely on firefighters. It is clear that any type of calamity, both fire and non-fire, can turn a situation into an emergency.To avoid causing harm to people, property, and the environment, emergencies call for immediate response [4], [5]. Riots, technological emergencies, and natural disasters make up the three main categories of emergency situations [5]. Emergency scenarios will increase risk, thus in order to lower the likelihood of disasters, technical malfunctions, or riots, it is required to increase non-structural risk reduction efforts in addition to structural risk reduction activities. This is accomplished by expanding the community's involvement in emergency preparedness, which includes raising awareness of emergency equipment [4], [6]. Since it is evident that many individuals still do not understand emergency equipment information effectively, community education about emergency equipment is conducted. The act, method, or process of knowing or recognizing is called recognition [4], [7].

A tool designated as personal equipment or equipment required during an emergency is known as emergency equipment [8]. By introducing emergency equipment utilizing 3D object models, which can depict the object as a whole and its construction and operation, people's inability to recognize emergency equipment can be improved [8], [9]. The technology of augmented reality, which mixes three-dimensional (3D) virtual things into a three-dimensional actual world and displays them in real time, will also be used in this study in addition to the use of 3D objects [10]. The usage of Augmented Reality technology because, in comparison to programs that do not use it, it can boost learning motivation [11]–[13].Due to its flexibility,

pocket book media is frequently used as a marker in augmented reality [14], [15]. Anyone who wants to learn about emergency supplies from physical media, such as pocketbooks, will find it convenient to use Augmented Reality in conjunction with the choice of pocketbooks as a medium for setting marks [16], [17]. Quizzes or practice questions to test previously taught information regarding emergency equipment will be integrated into the program in order to improve learning delivery. The Fisher Yates Shuffle algorithm, one of the effective randomization methods utilized in an application, is required to randomize quiz questions because this is necessary [18]. Based on this background, applications for introducing emergency gear have been designed and developed that use Augmented Reality technology and the Fisher Yates Shuffle algorithm.

II. THEORETICAL BASIS

The goal of augmented reality (AR) is to create technology that will enable real-time blending of digital content created by computers with the physical world. Augmented reality (AR) technology, as opposed to virtual reality (VR), which completely submerges users in a synthetic environment, enables users to see three-dimensional virtual items superimposed on the actual world [19]. For mobile devices, Vuforia is an Augmented Reality software development kit (SDK) that makes it possible to construct AR applications. Moreover, Unity offers the Vuforia SDK as part of its Vuforia AR Extension for Unity. Vuforia is a Qualcomm SDK that aids programmers in creating Augmented Reality (AR) applications for mobile devices (iOS, Android) [20].

Fisher Yates Shuffle is an algorithm that makes use of a random function, allowing it to produce values that are skewed (the results of Fisher Yates' randomization are hard to forecast the output pattern) [21]. This study employs cutting-edge techniques to apply the Fisher Yates Shuffle algorithm. In comparison to randomizing using previous techniques, Richard Durstenfeld's current Fisher Yates algorithm can lower the complexity of the process. The contemporary Fisher Yates algorithm was chosen because it has shorter execution times than the original method and provides more optimal randomization [22], [23]. The USE Questionnaire comprises 30 questions, which are broken down into four categories. When a user utilizes the application, each question serves as an assessment Four variables make up this questionnaire and are used to gauge customer satisfaction. These factors are utility, usability, learnability, and user pleasure [24].

III. METHODS

The first stage of this research is called observation of problems, during which problems are identified by making observations of circumstances or events that take place. By delivering questionnaires about knowledge of or information about emergency equipment to respondents, an online survey was conducted to track issues in this study.The second part of this research is acquiring information about the theories required for the design and development of flood, fire, and riot emergency equipment recognition applications. This is done through a literature review. These hypotheses cover information on augmented reality, vuforia, the Fisher Yates Shuffle algorithm, testing the degree of user comprehension in identifying emergency equipment by using the Pre-Test, Post-Test, and knowing N-Gain Score, in addition to assessing user satisfaction with the application for identifying emergency equipment for floods, fires, and riots based on measurements from the USE Questioner.The third step of this research is called "application design," and it is where the idea of creating the application that will be produced is discussed. The application's design will be broken down into numerous sections, including flowcharts that show how the application works, utilization of assets (such as 2D, 3D, and pocket book media), and licenses and databases required for the registration of markers for use in augmented reality. The process of describing how the application will be produced, known as the design of the application interface, is the last phase at this point. This step focuses on creating how the components and features will be displayed to the user when using the application.

The fourth stage of this research is the application stage, which is the implementation stage of the chosen and created design. By combining Augmented Reality technology with the Fisher Yates Shuffle algorithm, which is used to randomly generate quiz questions, an application will be created to present flood, fire, and riot emergency equipment. C# will be utilized as the programming language for creating

applications, and the Unity 2019 game engine will be used for application development.The fifth stage of this research involves testing applications that have been created in accordance with the design and so that they can be used in accordance with the objective for which they were created. Respondents who will utilize the Fisher Yates Shuffle algorithm and Augmented Reality technology's flood, fire, and riot emergency equipment recognition application will conduct tests. Using the Pre-Test, Post-Test, and knowledge of the N-Gain Score, the first stage of the test is to gauge how well the general public understands how to identify emergency equipment before and after using the application. The second stage is to gauge how well the users are satisfied using the USE Questionnaire and Likert Scale.

Respondents will participate in testing by first downloading and using the program, then filling out a questionnaire that has been created, and the findings of the questionnaire that the respondents have filled out will be utilized for evaluation.The following phase is the assessment phase, which in this study is the phase in which the answers to the questionnaires collected from participants during the application testing phase are evaluated. The evaluation analyses' findings are summarized, along with the level of user satisfaction with the application's ultimate outcome of identifying emergency equipment for riots, fires, and floods utilizing augmented reality technology and the Fisher Yates Shuffle algorithm. Writing a report, which is the last step in this research process, involves compiling the findings into a report. The steps used during the study process are detailed in the report, as well as the findings.Figure 1 shows the Augmented Reality flowchart from the category screen module. This Augmented Reality flowchart starts the first process by validating the marker which will check the marker whether available or registered in the database or not if yes then the emergency tool object will appear and if not it will revalidate. On the Augmented Reality screen there is also an arrow button which if pressed will bring up a component that has a navigation tab where the default of the tab will display the emergency tool detail information tab and users can switch to another tab that is the use of emergency tools.

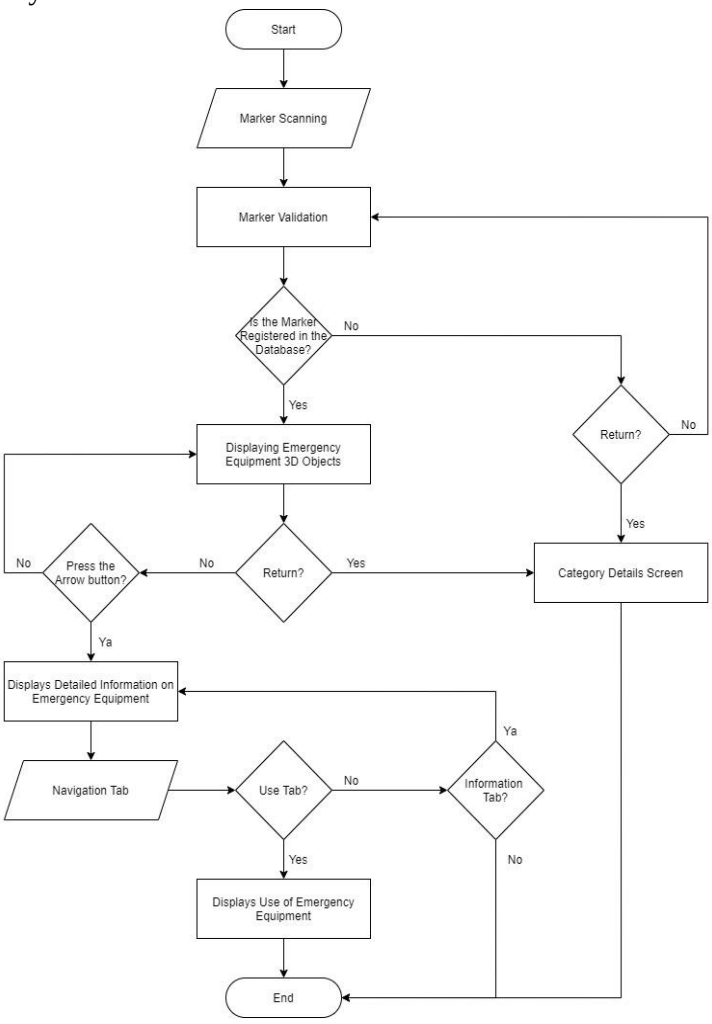


Fig 1. Augmented Reality Flowchart

The training screen module flowchart is shown in Figure 2. The user will be taken to the quiz exercise screen if the quiz exercise card is clicked. The first quiz exercise screen will display the start panel, and if the start button is clicked, the quiz exercise questions are randomized using Fisher Yates Shuffl. The exercise screen will display three quiz exercise cards based on emergency categories such as natural disasters, technological failures, and riots. Each of the quiz questions contains ten questions, After the user has completed the quiz exercise, the completion panel will appear, and the results or final value will be set with PlayerPrefs. Then the questions will show, and the user will answer the quiz exercises that are provided. The user may then select the home button on the finish panel to view the progress results of the quiz exercise that has been completed by using SetFloat(), a function that functions for the value will be supplied to the emergency equipment understanding feature and achievement.

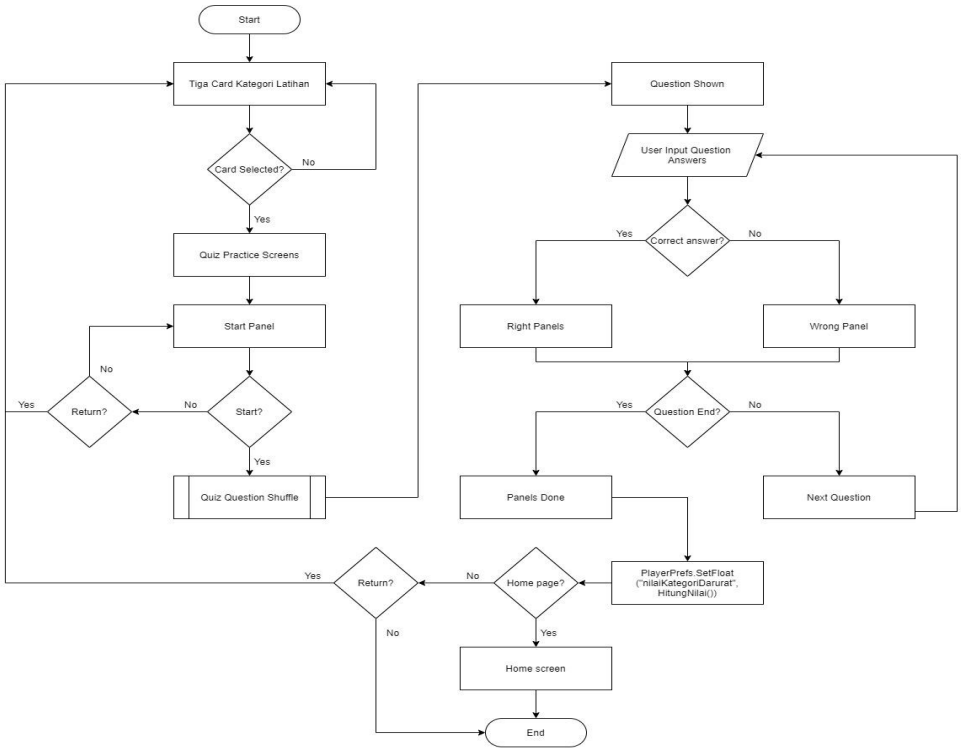


Fig 2. Exercise screen flowchart

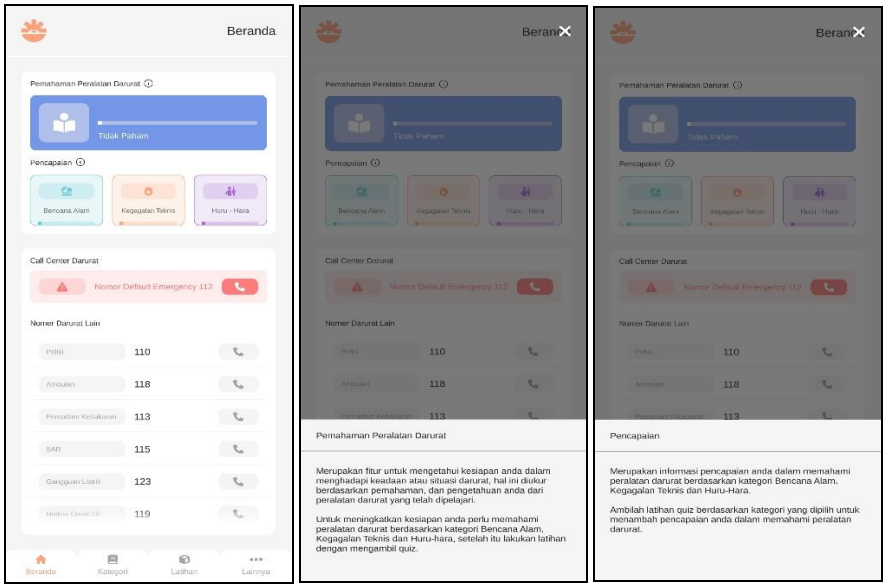
In Figure 5 is a display of the Fisher Yates Shuffle flowchart which is part of the exercise screen module. This Fisher Yates Shuffle flowchart aims to randomize or randomize questions that will be displayed on the quiz practice screen.

IV. RESULT AND DISCUSSION

In a quiz, there is a script called Quiz Question Control that generates and shuffles questions. The Fisher Yates Shuffle algorithm is used to shuffle the questions, and it is implemented in the ShuffleSoal() function. When the exercise scene is first opened by the user, the function is run, and the question index is randomized or shuffled as many times as the number of questions entered in the question list. The result is an index or number that has been randomized and is later stored in the randomSoals variable. Then, in the exercise scene, questions will be generated or displayed. The questions displayed are based on a list of questions that have been randomly selected using the index number in the randomSoals variable.When a user launches an application for the first time, the home scene, which is displayed in Figure 3a, is arguably the major scene.

The ability to dial a number of emergency numbers that have been provided is one of the aspects of the home scene, along with advancements in understanding emergency gear. Users can press the “i” icon to read more information about the progress understanding and achievement features if they are unfamiliar with them. Users can remove the modal detail information again by pressing the "X" icon in the top right corner of Figure 3b. Figure 3b also displays modal detail information from the emergency equipment understanding

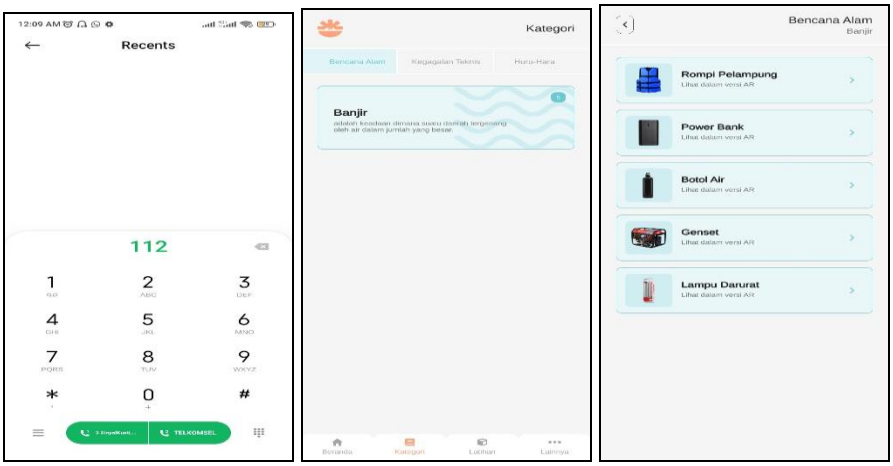
feature. Modal detail information serves to inform users of how the emergency equipment understanding feature can function properly and in accordance. Figure 3c shows a display of the accomplishment feature's modal detail information. This information explains to users how to utilize the achievement feature properly and appropriately. Users can also choose to again hide this information by clicking the "X" in the top right corner.



(a) (b) (c)

Fig 3. Homepage screen and emergency equipment comprehension modal

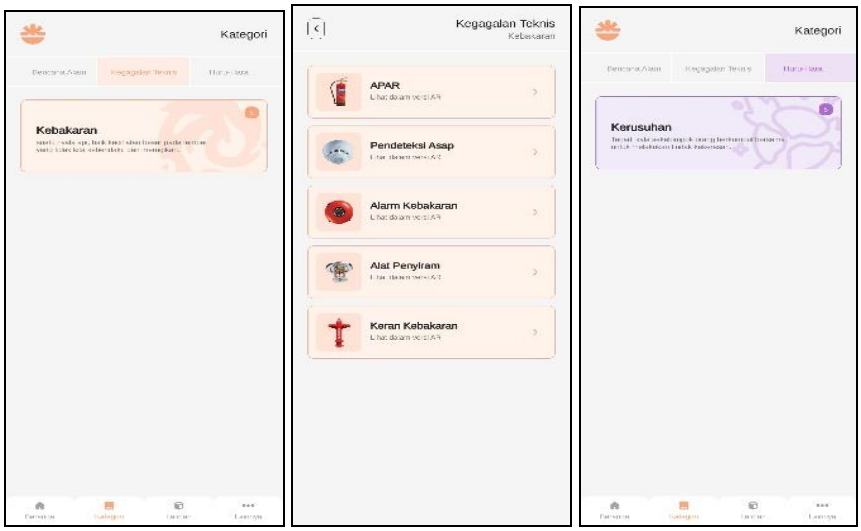
The emergency service that can be used in the event of an emergency by calling number 112 will be connected to the Emergency Call Center (Call Center 112) constructed by the local government. The display of the results when the emergency number button on the application is hit is shown in Figure 4a. After the user presses the emergency number button, it will automatically be directed to call the number. Users can touch the category navigation tab at the bottom to access the category scene. Figure 4b shows a view of the flood natural catastrophe category scene. When a user selects the flood card, they are then taken to the following scene, which has information on the flood natural disaster category, since there are only alternatives for flooding natural disasters in the natural disaster category scene. Figure 4c shows a setting representing a flood-related natural disaster. This image will show five pieces of emergency gear for dealing with flood-related emergencies, including life jackets, power banks, water bottles, generators, and emergency lights. The user will then be directed to the Augmented Reality scenario or be able to observe emergency equipment using Augmented Reality technology when they press the card of one of these emergency instruments.



(a) (b) (c)

Fig 4. Emergency number direct screen, screen of natural disaster categories and screen of flood natural disaster category

Users can access the category scene by pressing the category navigation tab at the bottom of Figure 5a, which shows a glimpse of the fire technical failure category scene. Only the choice for fire technical failure is available in the technical failure category scene; however, pressing the fire card by the user will take them to the following scene, which contains information about the fire technical failure category. There are five pieces of emergency equipment for scenarios or emergencies in the fire technical failure category displayed in the scene in Figure 5b, including fire extinguishers, smoke detectors, fire alarms, sprinklers, and fire taps. The user will then be directed to the Augmented Reality scenario or observe emergency equipment using Augmented Reality technology after pressing the card of one of these emergency gadgets. Users can touch the category navigation tab at the bottom to enter the category scene. Figure 5c shows a view of the riot category scene. There are only alternatives for riots in the riot category scene; nevertheless, pressing the riot card by the user will take them to the next scene, which contains information on the riot technical failure category.

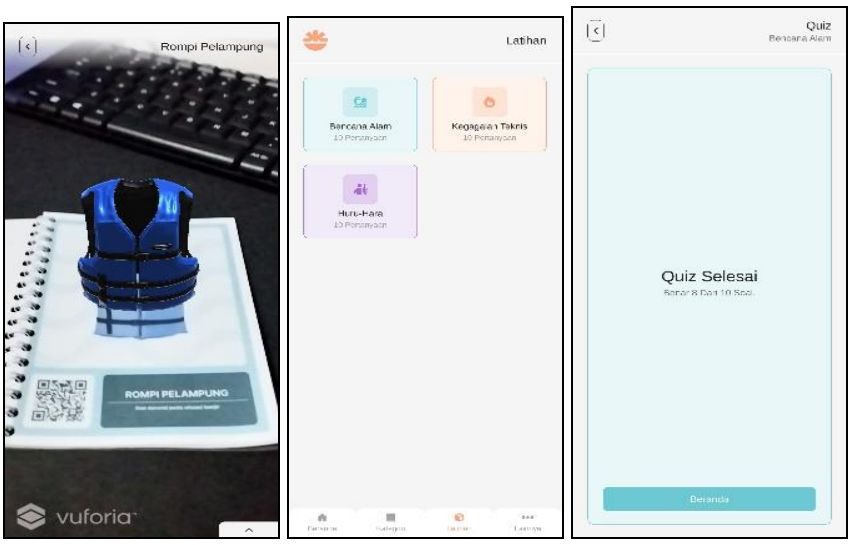


(a) (b) (c)

Fig 5. Display of technical failure categories, screen of fire technical failure categories and riot category screen

Figure 6a shows a scene from augmented reality where users can scan markers to access 3D objects from emergency equipment that has been selected in the detail scene category. If the scanning process is successful, the 3D object will then appear. Users can view extensive emergency tool information and return to the previous scene, which was category details, in this scene. The appearance of the workout scene is shown in Figure 6b, and users can access the exercise scene by clicking the exercise navigation option at the bottom. In the training scene, users are given three options for quiz exercises based on the categories of natural disasters, technical failures, and riots. Each quiz exercise will have ten questions, and if the user presses one of the quiz exercise categories, it will be directed to that category.

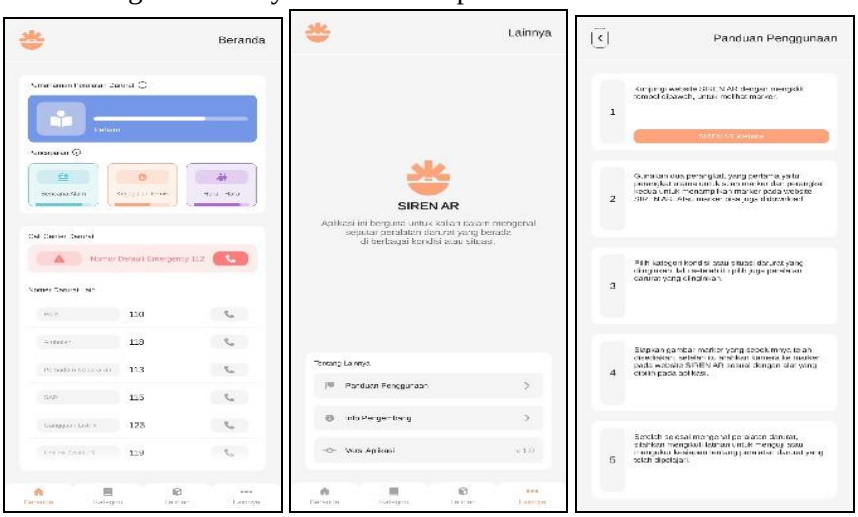
The exercise here aims to test users in understanding the introduction of emergency equipment for floods, fires, and riots. The start panel will appear when the user first enters the quiz exercise scene, serving to cover the quiz questions first and ask the user again whether they want to start the quiz exercise or not. If not, they can press the back button in the upper left corner, and if they want to start, they can press the yes button on the start panel. After the user presses the yes button, the start panel will disappear from the quiz exercise scene. Figure 6c shows a view of the start panel while it is still in the quiz exercise scene. The start panel appears when the user first enters the quiz exercise scene and serves to cover the quiz questions first before asking the user again whether they want to start the quiz exercise or not. If not, the user can press the back button in the top left corner. If they do, they can press the yes button on the start panel.



(a) (b) (c)

Fig 6. Marker scanning screen, exercise view and screen of completed quiz exercises

Figure 7a shows a progress display for the emergency equipment understanding feature and accomplishments on the home scene. Progress on these features can be attained and seen when the user successfully completes the quiz exercise; the feature's progress value is derived from the value that has been stored by PlayerPrefs.SetFloat and obtained using PlayerPrefs.GetFloat. Figure 7b shows the display of more scenes; users can access further scenes by selecting the other navigation tab at the bottom. There is some information in other scenes, including application descriptions, and various buttons for usage advice, development information, and application versions. Figure 7c shows a scene from the detailed usage guide. In this scene, the steps for using the application are shown in detail. At the first stage, the user can press a button to go to the Siren AR website and view the emergency equipment marker there. From there, they can proceed through the other stages until they reach the completion shown in this scene.



(a) (b) (c)

Fig 7. Progress screen on the homepage, Other views, Homepage view

Discussion

The output from the evaluation results of user understanding is to determine whether the user can understand and recognize emergency equipment by using the flood, fire emergency equipment recognition application, and riots using Augmented Reality technology and the Fisher Yates Shuffle algorithm. The results of the user understanding are based on the results of the Pre-Test and Post-Test questionnaires obtained from respondents during the application testing stage. Before completing the Pre-Test and Post-Test questionnaires, respondents must download the application from the download link provided on the Google form and give it a try. The questionnaire given to respondents will have five questions. Following the user's

trial run of the program, the respondent will complete a questionnaire based on their experiences both before and after using it, or what is referred to as the Pre-Test and Post-Test.It was noted that 50 respondents had successfully completed the Pre-Test and Post-Test of the flood, fire, and riot emergency equipment recognition application using Augmented Reality technology and the Fisher Yates Shuffle algorithm, as well as filled out the questionnaire, during testing and distribution of the questionnaire. The following stage is to calculate the Pre-Test, Post-Test scores and determine the N-Gain Score after the results of the data from the questionnaire are collected.From the average value obtained, it can be seen that the N-Gain Score is 57%, indicating that users are able to understand about emergency equipment effectively in accordance with the N-Gain effectiveness interpretation category when using the application of the introduction of emergency equipment for floods, fires, and riots with Augmented Reality technology and the Fisher Yates Shuffle algorithm.

Average of Post-Test scores as follows:
= (80+81+80+75+80)/5
= (396)/5
= 79.2

Average of Pre-Test scores as follows:
= (54+52+52+49+52)/5
= (259)/5
= 51.8

Average of Post-Test - Pre-Test Score as follows:
= (26+29+28+26+28)/5
= (137)/5
= 27.4

Average of the ideal score as follows:
= (46+48+48+51+48)/5
= (241)/5
= 48.2

Average of N-Gain Score as follows:
= (57+60+58+51+58)/5
= (284)/5
= 57%

The output of the user satisfaction evaluation is the level of user satisfaction with the flood, fire, and riot emergency equipment introduction application using Augmented Reality technology and the Fisher Yates algorithm Shuffles. The results of the user satisfaction evaluation are based on the results of the questionnaire obtained from respondents during the application testing stage. There were up to 30 questions given to respondents during the application testing stage, divided into 4 categories: usefulness (usability of the application), ease of use (ease of use), ease of learning (ease of learning), and user satisfaction (user satisfaction). Questionnaires were distributed using the Google form, and respondents could use the application by downloading it first on the link provided on the Google form.During the testing and dissemination of the questionnaire, 43 respondents completed the questionnaire and tested the flood, fire, and riot emergency equipment identification application using Augmented Reality technology and the Fisher Yates Shuffle algorithm.

The percentage score achieved will be determined based on the results of each question using a Likert Scale and the interpretation criteria of the respondents based on the results of the responses supplied.The percentage of users who were satisfied with the outcomes was 88%. This demonstrates that the application

for recognizing flood, fire, and riot emergency equipment using Augmenter Reality technology and the Fisher Yates Shuffle algorithm is particularly effective in getting users to promote it to their friends. According to the average value obtained, the final score of user satisfaction is 86%, indicating that the application of flood, fire, and riot emergency equipment identification with Augmented Reality technology and the Fisher Yates Shuffle algorithm is very effective in giving customer pleasure.

V. CONCLUSION

The application of the introduction of emergency gear for floods, fires, and riots utilizing Augmented Reality technology and the Fisher Yates Shuffle algorithm has been planned and built using Unity Engine 3D version 2019 and the C# programming language, according to the study that has been done. The successful implementation of Augmented Reality technology makes use of the Vuforia engine library as well as 3D objects that stand in for emergency gear, turning pocketbooks into marker media that can be helpful for scanning markers on Augmented Reality. The Fisher Yates Shuffle method is another successful use; the algorithm is effective for randomly generating quiz questions. Understanding emergency equipment, achievements, emergency phone numbers, viewing emergency equipment with augmented reality, and quizzes about understanding emergency equipment are just a few of the features that have been implemented in the application that has been created.

These features are very helpful in introducing users to emergency equipment based on and in accordance with the emergency conditions faced, such as natural disasters, technical failures, and other emergencies. The application will be tested on respondents or users to fulfill the results of evaluating user understanding with the Pre-Test, Post-Test, and user satisfaction with the use Questionnaire method after the application design and development process is complete. This build project will be carried out for Android or APK files. A total of 50 samples of respondents were obtained for the Pre-Test, Post-Test, and knowing the N-Gain Score, with the final result getting a score of 57% indicating that users when using the application are able to understand about emergency equipment quite effectively, and for user satisfaction with a total of 43 samples of respondents getting a final score of user satisfaction with an average of 86% indicating that the application is very effective from all aspects of usability.

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