MeeAR FIRE
AUGMENTED REALITY FIRE EXTINGUISHER APPLICATION FOR FIRE SAFETY TRAINING

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Augmented Reality Fire Extinguisher Application for Fire Safety Training

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.

ABSTRAK

Projek MeeAR Fire mempersembahkan pembangunan aplikasi Pemadam Api Realiti Tambahbaik (AR) - *(Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE)* yang bertujuan untuk meningkatkan latihan keselamatan kebakaran. Aplikasi inovatif ini membolehkan pengguna berinteraksi dengan senario kebakaran maya menggunakan teknologi AR, mensimulasikan situasi kecemasan yang realistik. Dengan menggunakan kaedah PASS (Tarik, Bidik, Tekan, Gosok), pengguna dapat mempelajari teknik yang betul untuk mengendalikan pemadam api dengan berkesan. Selain itu, aplikasi ini menawarkan kandungan pendidikan yang komprehensif mengenai pemadam api yang dikategorikan bagi memudahkan akses dan pemahaman. Tambahan pula, salah satu kelebihan utama MeeAR Fire adalah fleksibilitinya yang membolehkan pengguna mempelajari prinsip keselamatan kebakaran pada masa yang sesuai bagi mereka, tanpa perlu menghadiri sesi latihan keselamatan kebakaran tradisional. Aplikasi ini menyediakan pengalaman pembelajaran yang menarik dan immersif, memberi kekuatan kepada individu untuk memperoleh kemahiran keselamatan kebakaran penting di mana-mana dan pada bila-bila masa yang mereka inginkan. Melalui integrasi teknologi AR dan ciri-ciri interaktif, MeeAR Fire bertujuan untuk meningkatkan latihan keselamatan kebakaran dan meningkatkan persediaan pengguna dalam mengendalikan kecemasan kebakaran.

ABSTRACT

The MeeAR Fire project presents the development of an Augmented Reality Fire Extinguisher Application for Fire Safety Training aimed at enhancing fire safety training. This innovative application allows users to interact with virtual fire scenarios using AR technology, simulating realistic emergency situations. Using the PASS (Pull, Aim, Squeeze, Sweep) method, users can familiarise themselves with the proper techniques for effectively operating a fire extinguisher. Additionally, the application offers comprehensive educational content on fire extinguishers categorised for easy access and understanding. Users can also test their knowledge through interactive quizzes provided within the application. One of the critical advantages of MeeAR Fire is its flexibility, enabling users to learn fire safety principles at their convenience and eliminating the need for attending traditional fire safety instruction sessions. The application provides an engaging and immersive learning experience, empowering individuals to acquire essential fire safety skills wherever and whenever they desire. By integrating AR technology and interactive features, MeeAR Fire aims to enhance fire safety training and improve user preparedness for fire emergencies.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Nowadays, a rising number of cooperation have produced and generated a Virtual Environment (VE) and appointed Immersive Visual Technologies (IVT) consisting of Virtual Reality (VR) and Augmented Reality (AR) as the imminent future. (Saghafian, Laumann, Akhtar, & Skogstad, 2020) [3]. According to the statistic from ("VR/AR market size 2024 | Statista," 2021), the forecast market size worldwide from 2016 to 2024 is increasing to close to 300 billion U.S. dollars in 2024 rather than 2021 reaching 30.7 billion U.S. dollars. Therefore, ironically the global AR market size is predicted to advance in the coming years.

Augmented reality (AR) is the technology that enlarges the physical world by enhancing and boosting the objects in the real world with computer-generated perceptual information to create interactive experiences in a real-world environment. (Bellalouna, Luimula, Markopoulos, Markopoulos, & Zipperling, n.d.) [1].

Moreover, it also overlays the music, movies, and visuals on top of a pre-existing scene. Furthermore, adding graphics, sounds, haptic feedback or even smells to the natural world exists. Therefore, superimposing images in present situations requires four basic components: cameras and sensors, processing, projection, and reflection. (Maryville Online, 2021) [2].

Additionally, Augmented Reality (AR) will become more needed in industrial training technology nowadays. It will give the link of instructions to people or users on executing the services tasks. Thus, manually without AR involved, the task given will be complex to learn or perhaps will cost the variant of budget and skills expertise. Then, AR brings a way to assemble and maintain the job mission. AR also can include sub-skills training and the evaluation of the training system (Webel et al., 2013) [5]. However, using AR for training purposes will be more interactive and can combine multimedia together,

Besides, the AR system will help to get a guide to use the fire extinguisher in real-time physical drills. They can use the AR for training every time and everywhere without any concern about the major cost instead. The AR systems also give users real-time feedback after the training. Then, they will ace their skills and knowledge much better in the fire extinguishers.

1.2 PROBLEM STATEMENT

- Costly and time-consuming fire safety drills.
- Workplace risks with traditional training methods.
- Inadequate real-time safety information.
- Limited opportunity to learn about fire extinguishers during training.

The general problem of fire safety training for fire extinguishers can be defined as the cost of the period of time doing the fire safety drills in person (Syed, Fathima, & Aromar, 2018) [7]. They need specialised expertise to conduct the training. Some organisations or institutions instead must deal with them for providing the training. However, the equipment for the training needs to be completely listed before.

The issue that will be addressed is the workplace risk associated with traditional safety training methods (Gourley, 2020) [8]. The mentioned article highlights the need for offsite and open space locations to conduct training, as hazardous situations can arise both offsite and onsite.

Furthermore, real-time safety work packages lack detailed task-based safety information (X. Li, W. Yi, Hung-Lin C., Xiangyu W., Albert P.C. C., 2018) [9]. Training sessions often consist of a single demonstration with simple instructions, aiming to provide users with a general understanding of the outcomes. However, due to the large number of participants, users may not fully engage or pay attention during the training. The survey conducted among UMP students [6] revealed that approximately 20 respondents agreed that communication issues and misunderstandings can arise when training involves a large group of people.

The traditional method of training for fire extinguishers often lacks sufficient real-time feedback for each individual (Syed, Fathima, & Aromar, 2018) [7]. This limitation means that many users do not have the opportunity to acquire in-depth knowledge about fire extinguishers during training sessions, potentially leading to a decrease in their effectiveness when responding to emergencies.

1.3 AIM

- Real-time interactive AR technology to reduce training costs.
- Minimize accidents with AR training instead of traditional methods.
- Gain fire extinguisher knowledge.

Augmented Reality towards fire safety drills in training for fire extinguishers is one of the advanced technologies that interact in real-time movement and action. Therefore, the purpose of developing AR for training is to reduce training costs as mentioned the problem in (Syed, Fathima, & Aromar, 2018) [7]. Any workplace has rightly put first priority by investing the safety training in their employees instead. Therefore, it will be expensive overhead when the training is regularly performed. When AR is implemented in training of course it will cut down the financial outlay because the users can even access the training from their mobile phones instead of using the traditional classroom-based training that requires expertise and also the material involved.

Apart from that, as discussed by (Gourley, 2020) [8] the aim of using AR is to minimize the risk of an accident that will happen when the traditional method of training has been conducted. Moreover, when involved in classroom-based training, requires a bunch of people to watch the demonstration while it captures the real situation such as a huge fire and some of the dangerous equipment applied. However, it will be a high risk of accidents happening to everyone. AR is used to minimise the risk of the problem and to make fire drills training will become more reliable to be implemented.

1.4 OBJECTIVES

I. To study existing augmented reality fire extinguisher applications for fire safety training regarding the system features and drawbacks.
II. To develop an augmented reality fire extinguisher application for fire safety training.
III. To evaluate the functionality and usability of the developed augmented reality fire extinguisher application for fire safety training.

1.5 SCOPE OF THE PROJECT

The scope of the project covers a sample of the UMP institution population. That involves the staff and students using the augmented reality system for training purposes in fire safety drills for fire extinguishers.

I. Target User

The system totally covers UMP Institutions as the sample population for the usability of the system. The scope will contain all people inside UMP which are staff and students. They will benefit from getting a guide to use the fire extinguisher in real-time physical drills. The system will train them on the basic principle and practices of using extinguishers in fighting the fire. The system can be used as many as we want as no equipment is needed and minimises the level of cost. Moreover, the AR system will bring real-time feedback to users. Therefore, it will improve the skills of training individually.

II. Development of application

- Cover for 4 types class of fire extinguishers which are water, dry powder, foam and carbon dioxide
- The development is using Unity - Vuforia.
- Develop the element of 3D design for fire extinguisher models by using Blender.

- Implement multimedia elements which are sound effects, video, music and text.
- Develop by using marked-based augmented reality.
- The performance of the app depends on the hardware specification.

1.6 PROJECT SIGNIFICANCE

In the contemporary era of global pandemics, technology has become an integral part of people's lives. Even those who were once resistant to using technology now find it necessary to adapt. The world is continuously advancing in terms of technological updates, and it's conceivable that in the future, people may rely on technology to carry out daily activities, such as sleeping, eating, and relying on automated systems for various tasks.

One area that has been steadily gaining prominence is augmented reality (AR). AR has proven to have a significant impact on knowledge acquisition and addresses several challenges associated with traditional methods. It offers a way to minimize the need for extensive equipment and materials, especially in training scenarios. AR-based training is interactive and integrates digital elements into real-world environments, making it particularly beneficial for developing technical skills and completing multi-step tasks.

The application of augmented reality in fire safety drills for training on the usage of fire extinguishers focuses on enhancing safety through multi-step tasks. This particular study conducted its research using the UMP institution as a sample population. By implementing augmented reality, individuals can receive fire safety training that improves their emergency response skills. Real-time physical drills are utilized as demonstrations, eliminating the need for group gatherings.

Furthermore, implementing augmented reality training can significantly reduce the time required to organize training sessions where experts traditionally conducted live demonstrations to educate individuals on fire hazards and the proper use of fire extinguishers.

The augmented reality system provides a comprehensive guideline on fire extinguisher usage, enabling individuals to evaluate their own performance easily. This system is particularly valuable for those who wish to enhance their knowledge of safety measures during real-time fire incidents, considering the specific functionality of each type of fire extinguisher.

1.7 REPORT ORGANIZATION CHAPTER

Chapter 1: Introduction

Chapter 1 serves as an introduction to the project, focusing on the use of Augmented Reality (AR) in fire safety drills for training fire extinguisher usage. It highlights the drawbacks of traditional classroom-based training, using UMP institutions as an example. The chapter emphasizes the potential of implementing AR technology in UMP institutions to enhance fire safety training. Additionally, Chapter 1 clearly states the purpose of developing AR for fire safety drills and how it aims to increase awareness among the participants.

Chapter 2: Literature Review

Chapter 2 examines a comprehensive review of the existing literature on AR in fire safety drills for training fire extinguishers. It explores different systems and compares their advantages and disadvantages to determine the most suitable software for developing AR solutions in fire safety training.

Chapter 3: Methodology and Requirements

Chapter 3 focuses on the methodology employed in the project. It guides the developer in selecting the most appropriate methodology for developing AR for fire safety drills. The chapter also outlines the hardware and software requirements necessary for the development and implementation of AR in fire safety training. It further emphasizes the need to incorporate additional functional and non-functional requirements.

Chapter 4: Testing and Results

Chapter 4 concentrates on testing and the obtained results. It outlines the testing plans designed for evaluating the functionality of AR in fire safety drills. Both the developer and users actively participate in this testing phase. The chapter also discusses the constructive feedback received, which assists in enhancing the effectiveness of AR in fire safety training.

Chapter 5: Conclusion and Future Recommendations

Chapter 5 provides a summary of the project development, assessing whether AR in fire safety drills aligns with the set goals, objectives, and requirements. It also identifies limitations and constraints encountered during the development process. Additionally, the chapter suggests potential improvements and future features that could enhance the project's overall effectiveness.

CHAPTER 2

REVIEW OF EXISTING SYSTEMS

2.1 OVERVIEW

Formerly, in early metropolises began a new technology, and it has been raised from time to time to make life become easy and get the benefit from advanced machinery. Developers and researchers are working on developing augmented reality to solve real-time training problems. They aim to create simple procedures that require minimal participation from people, making training easier and more accessible.

One effective way to attract and engage the younger generation interested in technology creation is through fire extinguisher training. There are many apps available for training, particularly in fire extinguishers, which have rapidly gained popularity. Additionally, using augmented reality as a platform for training people on how to use or be aware of fire extinguishers shows that AR technology can provide real-time feedback. The developers themselves utilized AR as a solution to the problem of traditional fire extinguisher training.

Additionally, people can improve their fire extinguisher skills through frequent use of AR training, allowing them to effectively handle emergency fire situations. There are various apps globally that offer AR training for fire extinguishers, each with its unique approach and purpose. These apps educate users on the significance of fire safety and how to use fire extinguishers.

2.2 COMPARISON OF EXISTING SYSTEMS

In this section, we will examine the methods used by existing systems to train individuals on how to use fire extinguishers. Specifically, we will focus on the approaches taken by various AR training apps. We will review a few of these apps, including FiAR Fire Extinguisher, Test, and Test, which have been selected for evaluation and analysis.

2.1.1 FiAR FIRE EXTINGUISHER BY NORCAT INC.

Figure 2.1: A woman dealing with the AR FiAR app for training purposes in an emergency fire situation

In Figure 2.1, we can observe a woman utilizing the AR training provided by the FiAR app (NORCAT, 2019) [10]. She is using a screen tablet to interact with augmented reality technology. The FiAR app was developed internally in collaboration with North, with the primary goal of offering a unique and innovative fire safety training experience. The purpose of the FiAR app is to provide trainees with a personalized and immersive fire training session (FiAR - Fire Extinguisher, 2022) [11]. Whether the training is intended for business employees, managers, landlords, or renters, the FiAR app can provide engaging and practical fire safety training.

Figure 2.2: Type of extinguisher selection

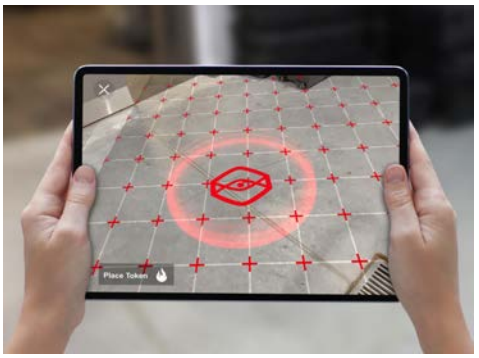
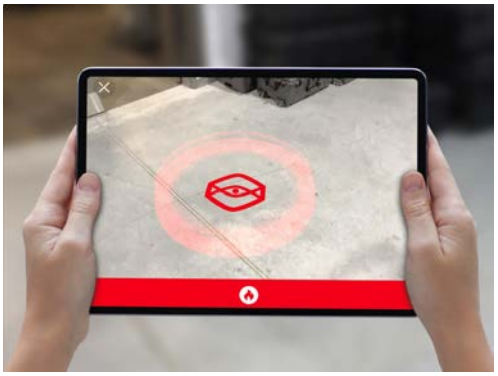
The system application displays the type of fire extinguisher selection so that the user can try the differentiation of each function on their selected. As shown in Figure 2.2 above, there are 7 selections of extinguishers that can be picked up. The goal of this selection is to help users understand how to use different kinds of fire extinguishers in various situations.

FiAR also allows us potentially to scan the environment, it also creates personalised fire training scenarios that include fire types, size, fire count, and sequencing of flames, among other things. Users can save and name the scenario once it's finished for future usage.

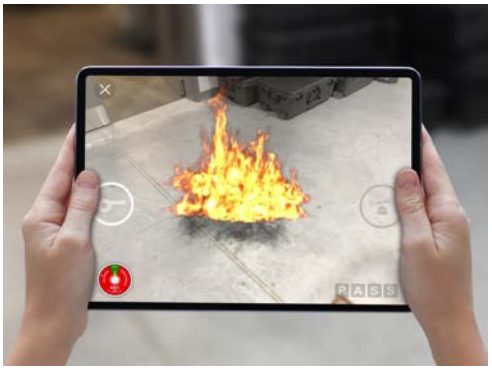
- **HOW DOES IT WORK?**

The application is under in-purchases, the developer gives the free usage on the app store for a trial version in order to user testing and looks over the app before they are interested to make purchases. The user needs to enter the app and then register as usual. Therefore, as shown in Table X below, the main interface will appear that consists of extinguisher education, start AR fire, Unlock full app and app settings.

Next, if the user chooses to start the AR fire, then the camera will turn on. The user needs to place the token as the target image to display the fire in static in order to make the fire stay in the specific place itself so that when the camera moves, the fire stays in the park. Therefore, the user needs to click the fire button to demonstrate the fire. Additionally, once the fire is visible, the user must select from a range of extinguishers to extinguish it. The FiAR app will provide instructions on how to use the chosen extinguisher.

FiAR functionality step
 Opening interface for the FiAR
 Option features of the FiAR
 Place the token where to place the fire
 Set the fire

Extinguisher selection



Action to begin

- **SUMMARY**

As A consequence of the FiAR augmented reality for the fire extinguisher, there are a lot of advantages of the app which are the variety of extinguisher selection that users can pick at one of each to put out the fire instead. The app also brings the technology of motion tracking where the user can select the target place for the fire to be placed in order to make sure it will stay in its spot location while the camera moves around.

Although FiAR offers a free purchase, the app has a drawback in that it does not provide a comprehensive guide on how to select the appropriate fire extinguisher before attempting to put out a fire. Moreover, the app should be used for error handling to ensure that users are aware of how to properly use the fire extinguisher in case of a specific situation.

2.1.2 FIRE FIGHTING PRACTICE FOR AUGMENTED REALITY BY ATOMA XR EDUCATION

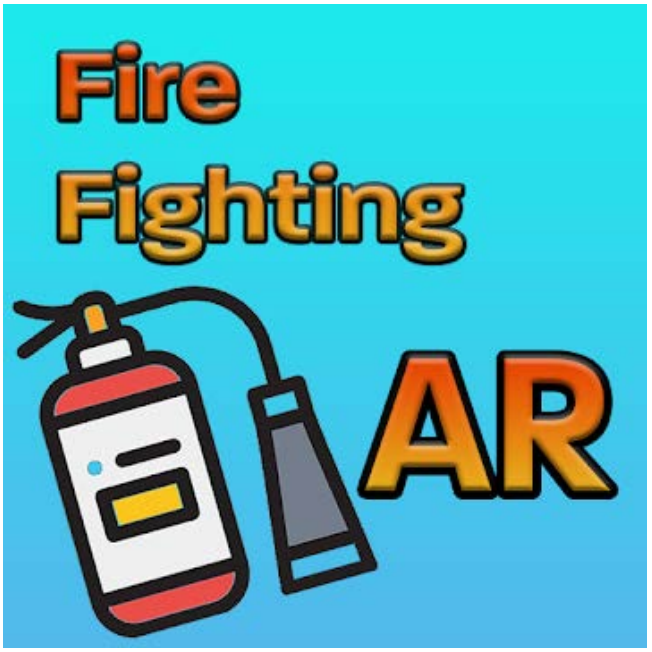


Figure 2.3: The logo of Fire Fighting AR

Fire Fighting AR is basically for a rapid method to learn how to use a fire extinguisher and also know functionality for each type of them (Fire Fighting Training - Virtual and Augmented Reality - ATOMA XR, 2021) [12]. The application only provides the 5 different fire extinguishers that are usually used to put out or deal with fire situations.

The benefit of the application is users can decide on the type of fire extinguisher to use, the following simple guides will help you use your extinguisher safely and prevent the fire from causing more havoc (ATOMA XR, 2013) [13].

Furthermore, the application also used the PASS method for learning methods using the fire extinguisher. By using the acronym PASS, it can easily be recited and recalled in the case of a fire. Below is the PASS definition.

Table 2.1: The definition of PASS acronym

Acronym	Stands for	Function
P	Pull the pin	After choosing a suitable fire extinguisher, pull the pin to unlock the fire extinguisher, which activates it for use
A	Aim at the fire	The fuel source is usually at the bottom, and by directly aiming at it
S	Squeeze the handle	The extinguishing component to be released
S	Sweep	Keep swinging the nozzle until the fire is completely put out

- **HOW DOES IT WORK?**

Figure 2.4: Interface in Fire Fighting AR

Figure 2.4 above shows one of the interfaces of the application in Fire Fighting AR. Moreover, the app displays the 5 different fire extinguishers which are dry powder, carbon dioxide, foam, water and also wet chemicals. Therefore, the application also displays the user guide for users to verify and read exactly the function of the fire extinguisher. Moreover, the app also provides a restart button so that users can reset it if they make any mistakes.

Figure 2.5: Fire extinguisher aims at the fire

The AR system of Fire Fighting AR system was developed with great technology, as shown in Figure 2.5 above for a detailed view, at the side corner there are words PASS. Therefore, users need to understand the meaning of the PASS acronym. When the user puts out the fire using the step then it will turn into light blue colour, else if the user does the wrong step the error sound will appear.

- **SUMMARY**

As a consequence of the Fire Fighting AR application, there are a lot of benefits to users using the application which are reminding the user how to complete the training using the PASS acronym. The application shows the guideline book for user reference to each type of fire extinguisher. The Fire Fighting AR gives experience to users for every 5 types of fire extinguishers to be implemented while learning the functionality of the type of each extinguisher itself.

2.1.3 PORTABLE FIRE EXTINGUISHER SAFETY TRAINING BY SENAR

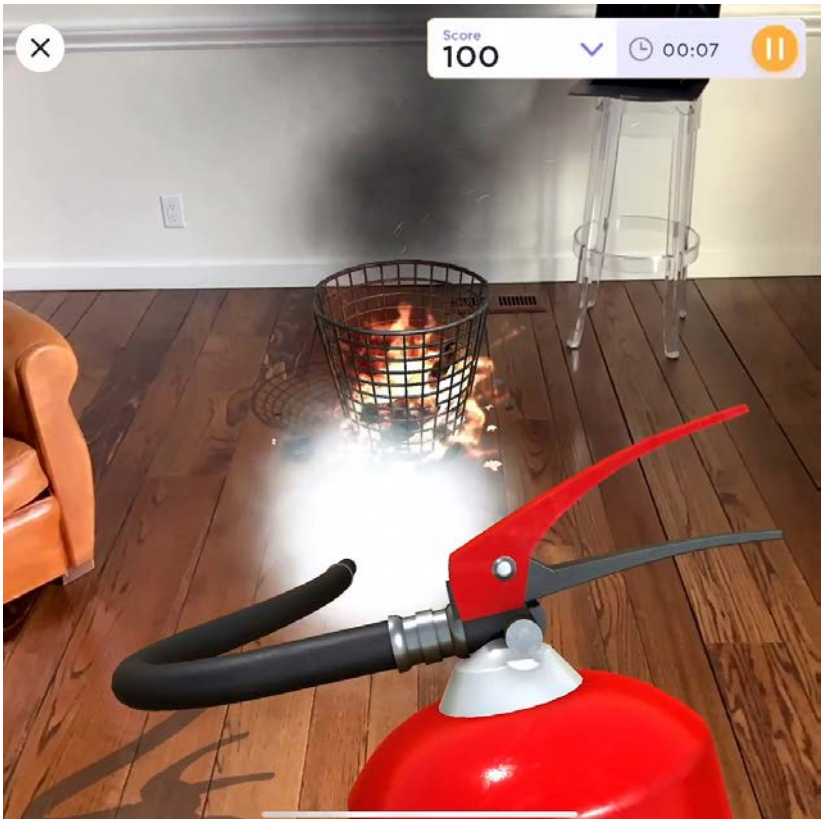


Figure 2.6: Fire safety stimulation

Figure 2.6 above shows the fire safety stimulation from SENAR company (*Fire Safety Training in Augmented Reality (AR)*, 2022) [14]. They used stimulation from virtual reality in order to conduct the training for fire extinguishers. This simulation aims to teach people how to respond during a potential fire emergency. By using VR technology, users can visualize themselves in a similar environment to the real world.

The application has four(4) scenarios that the user itself can be implementing toward the environment such as electric cabinet, gas furnace, wastepaper basket and overloaded electrical outlet, which for each scenario are represented the types of extinguishers. display the score and timing to be calculated in order to get the VR training more interesting.

Also, the application shows multimedia effects such as fire audio, people walking, any step sound and more so that it will make the training more amusing and attractive to the real world. In terms of the user guide, the application has implemented guidelines on how users themselves communicate when a fire situation happened such as starting by sounding the alarm, tapping the fire extinguisher pin to pull it out and so on.

- **HOW DOES IT WORK?**

Portable fire extinguisher safety training by SENAR has been implemented in virtual reality with multi-step tasks and advanced simulation-based training where the users can work on reactions in hazardous situations.

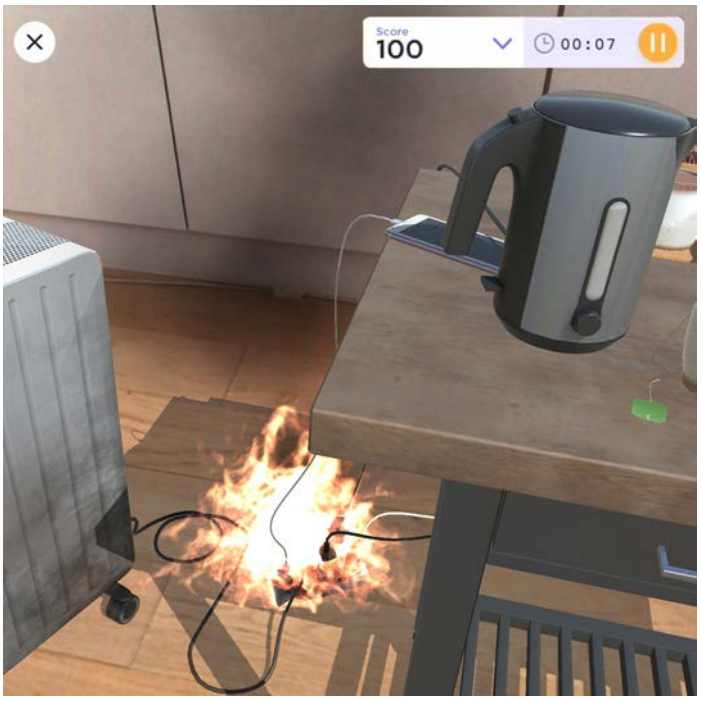


Figure 2.7: A fire breaks out in an electrical cabinet

Moreover, the application develops for users to do training for the fire extinguisher. Users are provided with a realistic simulation environment as a real one such as in a pantry. Users need to walk around the pantry then the fire that breaks out will trigger. As shown in Figure 2.7 a fire breaks out in an electrical cabinet as a result of a damaged plugin.

Users need to solve the problem by turning down the fire using the extinguisher provided, here guidelines will pop up and display on the screen as shown in Figure 2.8 below. However, users also will train on how to figure out the cause of how the fire breaks out was happening in order to opt for a suitable extinguisher.

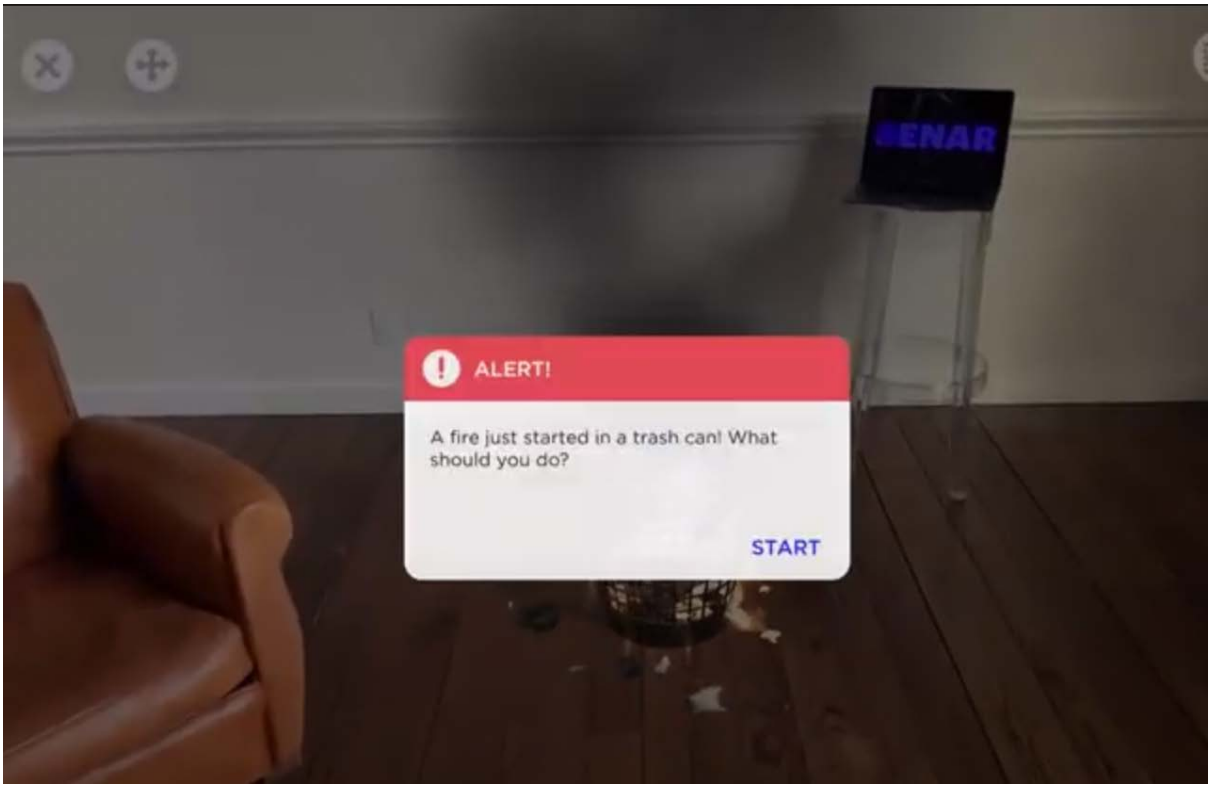


Figure 2.8: Guidelines will pop up and display on the screen

Furthermore, when the training is successfully done. Users will get real-time feedback from the system in particular and also the time taken to put out the fire. Also, the score will be given on how the user itself handles the situation against the time speed.

- **SUMMARY**

SENAR's portable fire extinguisher safety training serves as an excellent example for implementing augmented reality (AR) technology. This application showcases various elements that offer users a unique experience within a virtual environment. The inclusion of a timer and scoring system adds an interactive aspect to the training, rewarding users upon successfully completing challenges. Additionally, the application provides error handling mechanisms, such as displaying warnings when trainees fail to maintain a safe distance. However, it is crucial to incorporate clear guidelines on how users should respond and effectively utilize a fire extinguisher in the event of a fire outbreak.

2.3 COMPARISON OF THREE ATTENDANCE APPLICATIONS

Table 2 is shown the overall comparison between three existing applications in AR for training fire extinguishers. Therefore, the content consists of the graphical user interface, size, programming language used, target use, type of AR, seller by, AR category, version, functionality, advantages and disadvantages.

Table 2.2: Comparison of three existing system

Functions / features	**FiAR FIRE EXTINGUISHER**	**FIRE FIGHTING PRACTICE FOR AUGMENTED REALITY**	**ROBI FIRE**
Logo			
Link sources	(1) shorturl.at/ahnK9	(1) shorturl.at/lCD69	(1) shorturl.at/tuDNS (2) shorturl.at/atHP5
Required	iPadOS 11.3 or later	Android 7.0 up to	Android 8.0+ (Oreo, API 26)

Platform	iPad	Phone or Tablet	Phone or Tablet
Size	1 GB	35M	30.9 MB
Programming language	C#	C#	C#
Target user	Profession and community	Public	Profession and Public
Type of AR	Marker less-based	Marker less-based	Virtual Reality
Seller by	NORCAT INC	ATOMA XR EDUCATION	SENAR -uploaded by Pedro Henrique
AR category	Core and Entertainment	Entertainment	Productivity
Latest updated or version	Version 1.3.0	July 8, 2020, for version 1	Version 3.18
Features	(1) Location tracking (2) Extinguisher education	(1) Feedback (2) User guideline (3) PASS method	(1) Timer (2) Score (3) Guideline (4) Real-time feedback
Functionality	1. Help you deliver engaged and meaningful fire safety training, whether you are training corporate employees, managers, landlords, and tenants.	1. Practise various response methods to in different types of fires, using OSHA standards to apply the fundamentals of firefighting	1. Provide user error handling that allows users to deal efficiently in training 2. Provide score and timer to make the training more

	2. Deliver realistic true to life fire training experiences to your industrial workforce		challenging
Advantages	1. Variety of fire extinguisher selections 2. Place detected to spot of the fire position 3. Error handling when the user makes some mistake	1. Provide real-time feedback to users when they put out the fire by using PASS method 2. Place detected to spot the fire position	1. Having error prevention that benefits the user itself to acknowledge the mistake happened 2. Feedback after training is complete
Disadvantages	1. Does not have a user guide when the user puts out the or what the user needs to do next	1. There is no static fire location which means when the user lost track of the target fire then the training will stop the need to start again	1. There are limited buttons on the interface display such as user guidelines, information and setting.

According to the provided table, the comparison of the three existing applications indicates the importance of comprehensive user guidelines and informative content related to fire extinguishers. It is crucial for the Augmented Reality Fire Extinguisher Application for Fire Safety Training in this project to include user-friendly functionality, such as information provision, settings options, and clear user guidelines. These features aim to offer users meaningful and relevant experiences throughout the training process. The interface of the AR Fire Extinguisher Application for Fire Safety Training should follow 3 important principles which are to provide informative feedback, prevent error as much as possible and minimize memory load. For example, the back button, real-time feedback, use of familiar icons or etc.

CHAPTER 3

METHODOLOGY

3.1 OVERVIEW

Hence, in order to ensure the system will work excellently, it needs a significant development of methodology. Moreover, a complete and comprehensible development will be able to develop within the budget and the time constraint. This chapter will introduce the methodology of the Augmented Reality Fire Extinguisher Application for Fire Safety Training.

Furthermore, the Augmented Reality Fire Extinguisher Application for Fire Safety Training will help particularly UMP students as a sample of their skills to deal with emergency fire situations and get real-time feedback from the system, while educating the student about the importance of fire safety by using a fire extinguisher.

3.2 METHODOLOGY

The methodology is one of the most crucial steps in the development of the system. The development can be represented in plan, design, development, testing and implementation, the activities can be broken down into accurate levels. Moreover, there are several software models available, but the ongoing system that has been implemented will be known as the best model to employ (Tiky, Y. T. W.,2016) [15].

The software development methodology that will be used is Rapid Application Development (RAD). RAD is a development methodology that emphasises fast prototyping and feedback over prolonged development and testing cycles. RAD allows developers to make several iterations and modifications to the software without having to restart the development process from the beginning each time.

Rapid Application development differs from other software development models by a significant amount (admin, 2022) [16]. Obviously, the most significant distinction is how RAD prioritises speed above other models, which often prioritise providing a functional product to the client. Another factor to bear in mind is that RAD prefers a single team with a small number of people. This enables quick communication and information sharing through brief meetings. Other development models, such as the waterfall model, prefer a bigger team with various expertise.

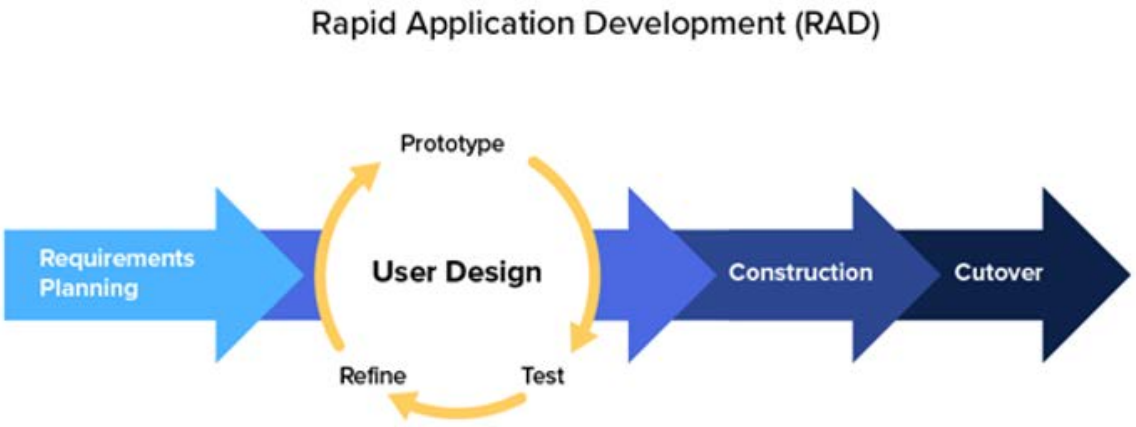


Figure 3.1: Rapid Application Development Diagram

The RAD development path is provided for developing systems faster while reducing cost and increasing quality. Prototyping is used to help users visualize and request changes to the system as it is being built, allowing applications to evolve iteratively. The structure of the RAD life cycle is thus designed to ensure the building of the systems that are really needed. This life cycle has four stages, including all of the Requirements Planning, system design, development and cutover tasks (*What Is Rapid Application Development? I*, n.d.) [17].

3.3 RAD IMPLEMENTATION

1. Requirement Planning

The aim and purpose of doing the requirement planning phases is to identify the problem statement, objective and scope of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE. Therefore, the planning is defined to make sure the next phases will have fewer of issues, and errors and at the same time reduce cost.

There are 3 (three) tasks for collecting the requirement for planning phases which are current situations, defining requirements and finalising requirements.

Moreover, for the current situation basically doing the research on articles, journals or etc towards Augmented Reality Fire Extinguisher Application for Fire Safety Training -MeeAR FIRE. There are different approaches by them to discovering the AR in their project which are using markless, mark based or even used both. For certain research, they develop AR using different methods. Here, by having collected the requirement for the planning phases, we can make sure our product is standardised and accurate to be developed.

Furthermore, for the defined requirement, the task is creating an outline of the AR system and the definition of the scope in particular. Moreover, this phase will identify the aim and scopes of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE respectively which is related to the approaching of the AR environment itself. The functionality of the AR is approached by the process and the data will be supported (Zirawaga, 2017).

Next, finalize requirements where all are documented including the problem statement, objectives, scopes and more. Therefore, this phase is required to plan the approximate duration or milestone of the entire project in order to make sure of no delays and completion on time.

2. System User Design

In this phase, the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE will analyze particularly the detail of the associated and appropriate design structure for the proposed design.

Before the MeeAR FIRE is produced, there are ways to examine the concept and how the system works in detail. In addition, the system will generate a complete MeeAR FIRE model, outline the MeeAR FIRE design, and an implementation plan to aid in the specification of software and hardware requirements. Also, the scene design will focus on the user interface and multimedia elements. Some materials used will be made by myself such as using the blender software to create a fire extinguisher while some will use models from the online store.

3. Construction

The Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE development will be used in Vuforia Unity Engine. The environment of the MeeAR FIRE will be designed first before implementing the contents. Using Unity as AR development of MeeAR FIRE is great for interactive visualisation implementation. Therefore, Unity used simple language programming which is C# which is the big advantage of the approach (Dolan, 2019).

In this phase, will be implemented the functionality and all types of features that were designed in the previous phase; flowchart planning and design. That consists of the buttons, images, audio etc.

HARDWARE AND SOFTWARE REQUIREMENT

The hardware and software requirements for Augmented Reality Fire Extinguisher Application for Fire Safety Training- MeeAR FIRE are described or stated in Table 3.1 and Table 3.2 below.

A. Hardware Requirement

Table 3.1: Hardware

Hardware	Purpose
Macbook M1	To run all the software
Wireless Router	To provide connection to the laptop.
Printer Pixma MP287	To print the document related to system

B. Software Requirement

Table 3.2: Software

Software	Purpose
Microsoft Word 365	● To edit and prepare my proposal ● To design the use case diagram, context diagram, flowchart, data flow diagram and others.
Adobe acrobat pro	● To read the existing thesis from other sources
Google Chrome	● To search and find any information related to my project
Unity	● To develop the augmented reality
Blender	● To design the 3D model of project

4. Cutover

The Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE will be tested before it runs to be executed to the real target user. It needs to ensure the MeeAR FIRE functionality works very well and performs as expected. Therefore, in the cutover phase, we also need to create unit tests and validation procedures and document the technical specifications so that we can easily recognize the problem after.

Implementing the alphas and betas in developing AR for the MeeAR FIRE, below is some explanation:

Table 3.3: Types of testing

TESTING	DESCRIPTION
Alpha	● The first testable version is done by the developer. (*What Are Alphas and Betas in Video Games?* 2021) ● MeeAR FIRE might crash and not have all the features implemented as expected. ● The aim of the alpha testing is for where developers need to find the possible worst bugs that affect the goal of the MeeAR FIRE.
Beta	● The second testable version is done by real users or end-users of the MeeAR FIRE with all the features and functionality but with bugs and possible crashes. (*What Are Alphas and Betas in Video Games?* 2021) ● In this Beta testing, developers are not present ● Beta testing is performed to check the software's quality, reliability, usability, accessibility, etc. before moving it to the market.

3.4 ADVANTAGES OF USING RAD

Table 3.4: Features of RAD

No	Model/features	Rapid Application Development(RAD
1.	Well-defined requirement	Yes
2.	User involvement in all phases	Only at the beginning
3.	Overlapping phases	No
4.	Implementation Time	Quick
5.	Cost	High
6.	Incorporation of changes	easy
7.	simplicity	Simple
8.	flexibility	High

3.5 PROJECT REQUIREMENT

The primary purpose of this phase is to document all processes that participate in the system development. Project requirement can be defined as an outcome that must be required into specific functionality and non-functionality of the system performance. It represents the need for the system, which benefits if it develops that must be entirely discovered by the developer of the Augmented Reality Fire Extinguisher Application for Fire Safety Training itself.

Essentially, this chapter also explains the Augmented Reality Fire Extinguisher Application for Fire Safety Training development that was discussed in previous phases. The content of the implementation depends on the project developed.

3.5.1 FUNCTIONAL REQUIREMENT

The definition of functional requirement can be defined as vary depending on the specific scenes, module or even the program and its intended audience. Therefore, it also has a process that refers to the needs of its users on how the system should perform.

i. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to choose randomly by the option given.
ii. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to rotate the 3D fire extinguisher.
iii. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to show and hide the panel.
iv. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to track the image to get an outcome which is the audio and 3D object.
v. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to track the markless fire to the ground plane.
vi. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to perform a quiz and get the result.
vii. Augmented Reality Fire Extinguisher Application for Fire Safety Training shall allow users to communicate all the functionality of the system, such as being able to click the button to the scene correctly.

3.5.2 NON-FUNCTIONAL REQUIREMENT

The definition of functional requirement can be defined as imposing constraints on the design or implementation that performed the qualities or even characteristics of the system. Therefore, it is considered acceptable and valuable to users and how the system should perform.

A. Performance

Some Performance requirements identified are listed below for Augmented Reality Fire Extinguisher Application for Fire Safety Training:

I. The system shall support the use of multiple attempts at a time.
II. The application shall return results with a fast response.
III. Application performance change shall work well even with set workloads.

B. Maintainability

I. The user can reset the stimulation of the system to default settings.

II. Users can click the back button to go to the previous scene.

C. Reliability

I. The result of the quiz shall appear correctly according to the user's answer.

II. The quiz will pop up the answer before going to the next question with an accurate timescale.

III. Image tracking accurately appears the correct 3D object and audio according to the setting.

Refer to Chapter 5 for project limitations and constraints

3.7 USER REQUIREMENT

A. Requirement planning pre-market survey

The pre-market survey was taken during the requirement planning phase. It is based on researching current situation tasks in order to get real user feedback on the problem observation.

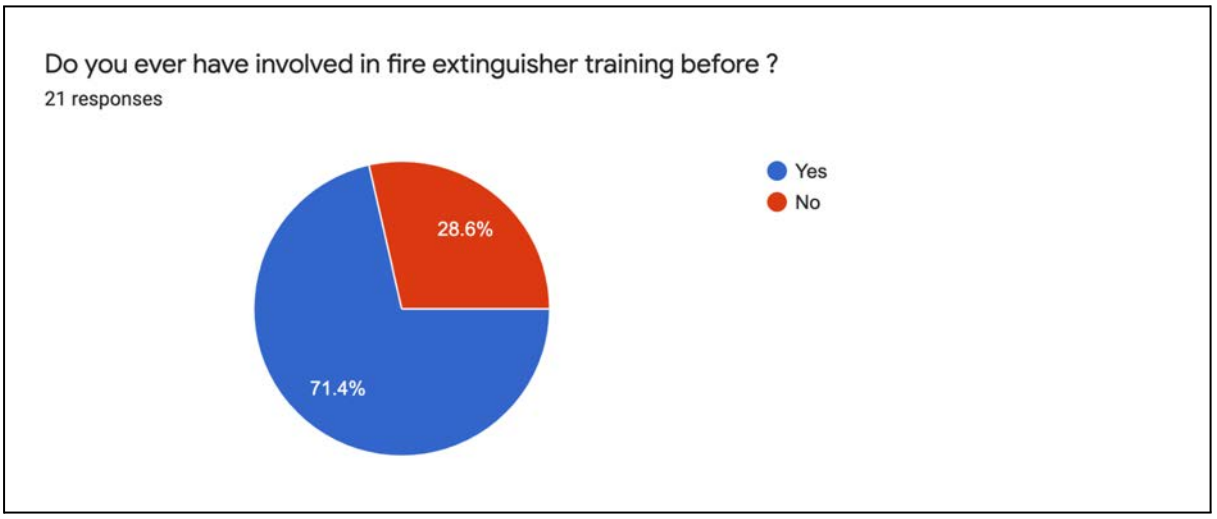


Figure 3.2 : Survey involving training on fire extinguishers

The question of this survey has been asked about involving fire extinguisher training. The responses have reached 21 responses, and about 71.4% agreed that they do not ever involve in fire extinguisher training before. Therefore, the rest is about 28.6% of counts that do not involve the training before.

The index of the survey is to observe the contribution of users themselves regarding the safety fire extinguisher training. Moreover, the significant development of the MeeAR FIRE augmented reality system for people already involved is to recall the steps and knowledge about safety. Therefore, significant for people not involve before is they can completely benefit from the MeeAR FIRE augmented reality system to gain the skills and understanding of fire extinguisher safety.

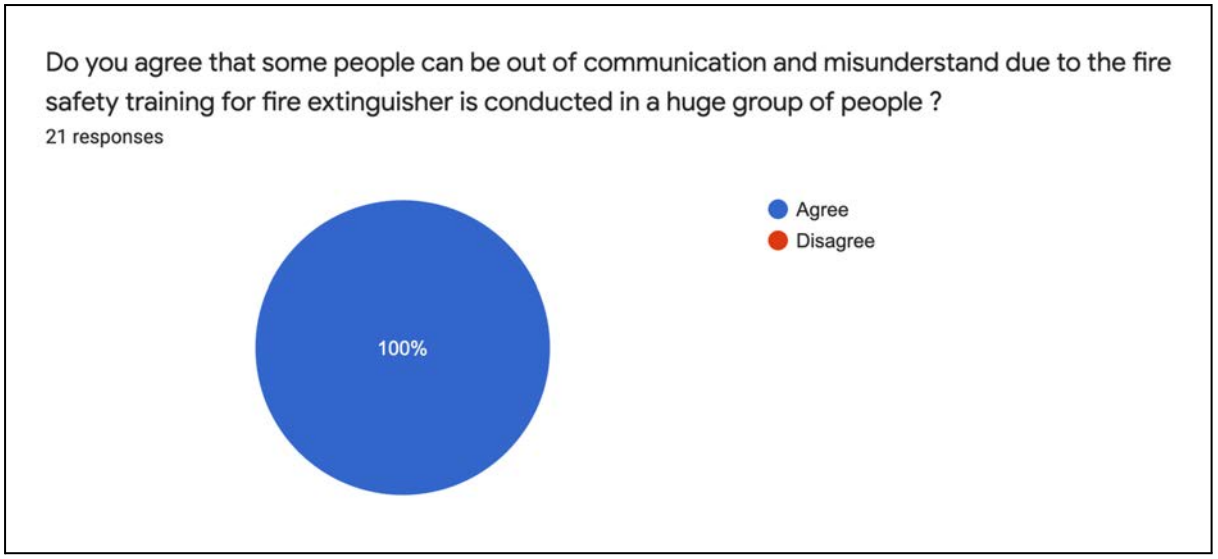


Figure 3.3: Survey on the scenario in manual safety training

The question of this survey has asked about the scenario that happened during the traditional method of safety training for fire extinguishers. Furthermore, 21 respondents agreed that they faced problems understanding fire safety training when conducted in a huge group of people.

The index of the survey is to observe the contribution of users themselves and how would they feel if there is an application to help them to understand safety fire extinguishers that involve a real-time environment without attending in a crowded place to learn all about them.

B. System design pre-market survey toward development process

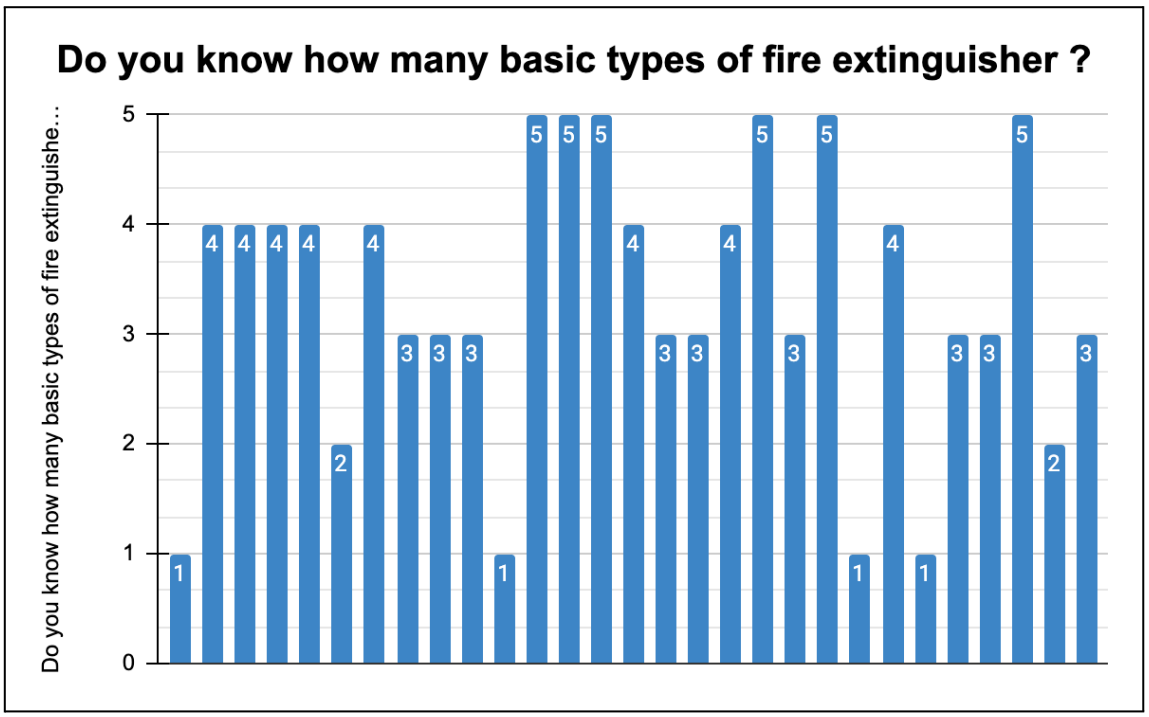


Figure 3.4 : Survey asking how many basic types of fire extinguishers

The question of this survey has asked about how many basic types of fire extinguishers. The survey reached 29 responses total. The precise answer for how many basic types of fire extinguishers are types respectively. Therefore, only 6 respondents answered correctly then the rest were completely wrong.

The index of the survey is to observe the contribution of users themselves and acknowledge how many types of fire extinguishers. Regarding the survey, most people do not encourage how many types of fire extinguishers. Moreover, MeeAR FIRE augmented reality system can help them gain more knowledge about fire extinguishers.

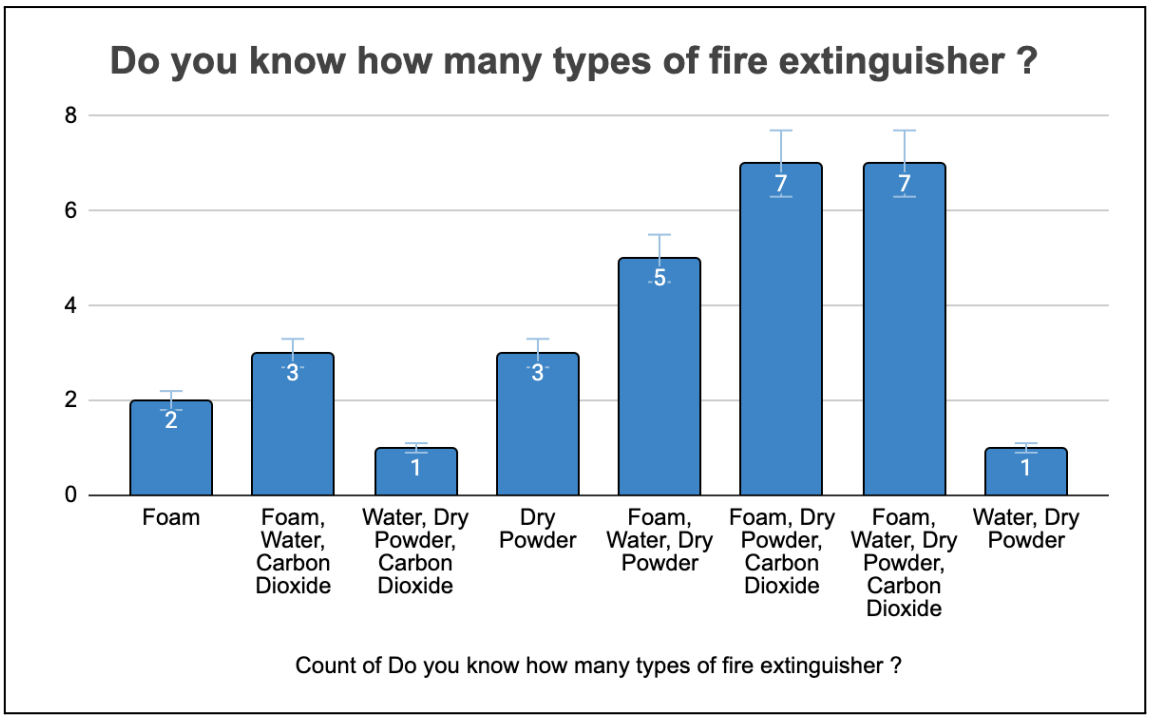


Figure 3.5: Survey asking how many types of fire extinguishers

The question of this survey has asked about how many types of fire extinguishers. The survey also reached 29 responses in total. The accurate answer for the types of fire extinguishers consists of foam, water, dry powder, and carbon dioxide. Therefore, only 7 of the respondents answered correctly then the rest were completely wrong.

The index of the survey is to observe the contribution of users themselves to acknowledge the types of fire extinguishers. Regarding the survey, most people do not encourage types of fire extinguishers. Moreover, MeeAR FIRE augmented reality system can help them gain more comprehension of fire extinguishers.

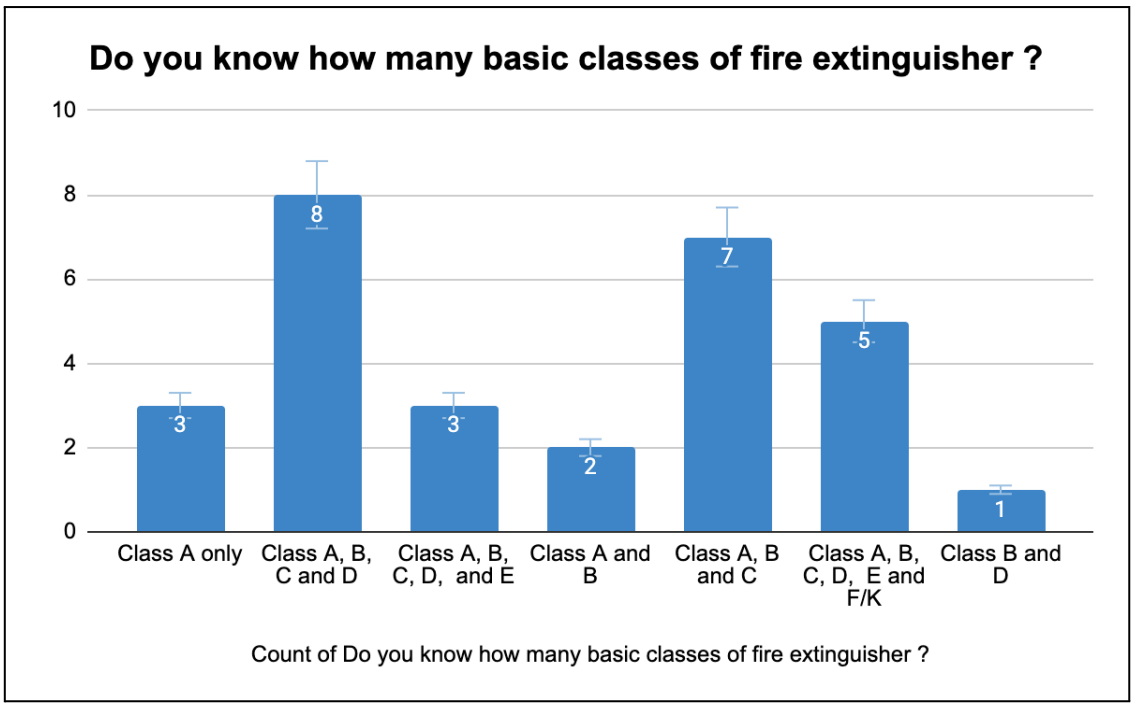


Figure 3.6 : Survey asking how many basic classes of fire extinguishers

The question of this survey has asked about how many basic classes of fire extinguishers. The survey also reached 29 responses in all total. The exact answer for how many basic classes of fire extinguishers is class A, B, C, D, E and F/K respectively. Therefore, only 5 respondents answered correctly then the rest were completely wrong.

The index of the survey is to observe the contribution of users themselves and acknowledge how many classes of fire extinguishers. Regarding the survey, most people do not encourage how many classes of fire extinguishers. Moreover, MeeAR FIRE augmented reality system can help them gain more awareness about fire extinguishers.

Figure 3.7: Survey asking when they have been taking practised the training for fire extinguishers

The question of this survey has asked about the exact time when they have been practising the training for fire extinguishers. The survey also reached 29 responses in all total. The options are within 1 month, 6 months, and can not remember. Therefore, about 23 respondents can not remember, 2 respondents for 6 months and 4 respondents for 1 month.

The index of the survey is to observe the contribution of users on the exact time they do training for fire extinguishers. Regarding the survey, most people do not remember how exact time duration of practised fire extinguisher safety.

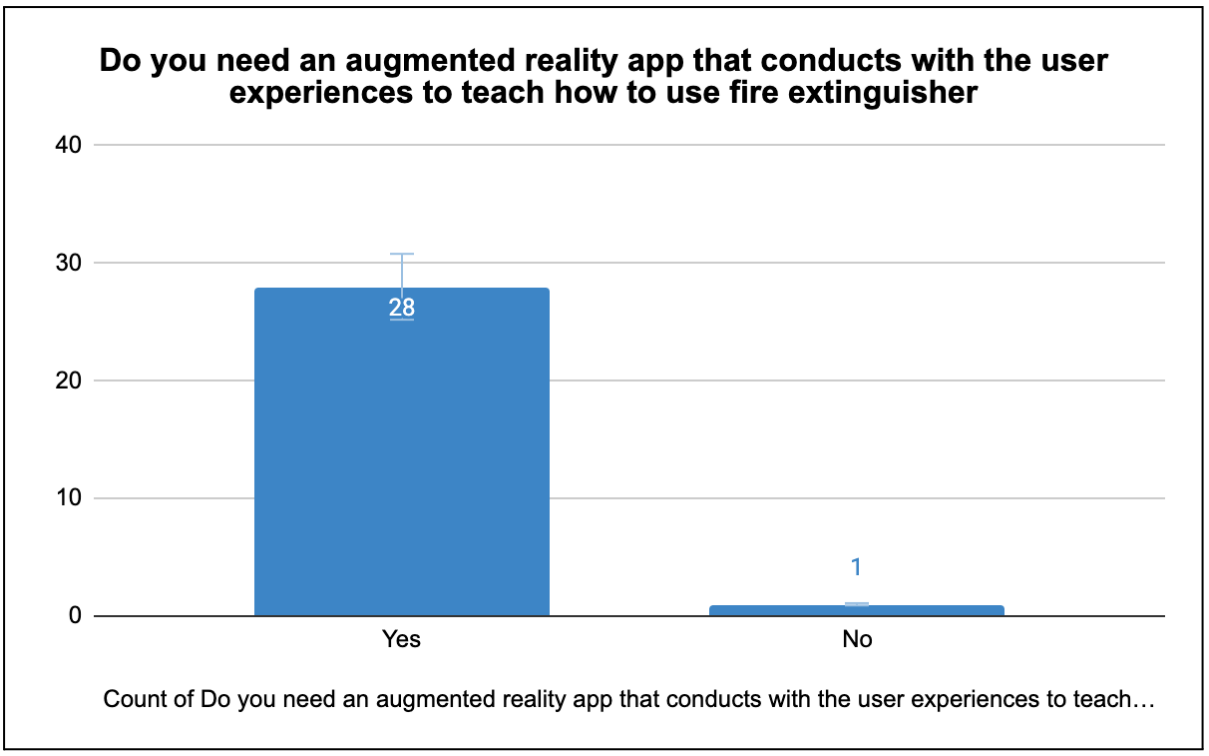


Figure 3.8 : Survey asking for needed development of AR for fire extinguisher safety training

The question of this survey has asked about the needed development of AR for fire extinguisher safety training. The survey reached 29 responses in all total. Therefore, about 28 respondents agree then 1 respondent disagrees with the construction of AR for fire extinguishers.

The index of the survey is to observe the contribution of users needed toward developing the AR for fire extinguishers.

3.8 CONTEXT DIAGRAM

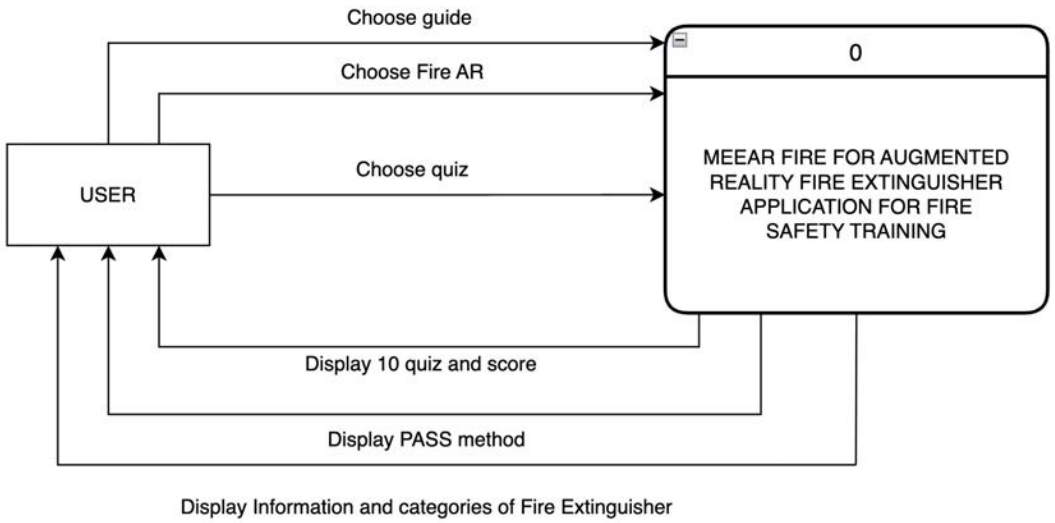


Figure 3.9: Context diagram for the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE

Figure 3.9 is the context diagram of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE. The context diagram contains all the input and output based on the entities interacting with the system altogether. Moreover, the user will choose the options in the system that have Guide, Fire AR, Information and Exit buttons then the system will interact with the user and display the information regarding the chosen one. Next, the user can have a variety of selections for example, Guide module, sub-module is Rotate Fire Extinguisher, AR Information Fire Extinguisher, AR Teacher for Fire Extinguisher, and Contact Us. The fireAR app offers various options for selecting the PASS method. Additionally, users can try out the quiz module, which requires them to answer ten questions and provides a scoreboard at the end. The app facilitates interaction between the user and the system, serving as both input and output.

3.9 USE CASE DIAGRAM

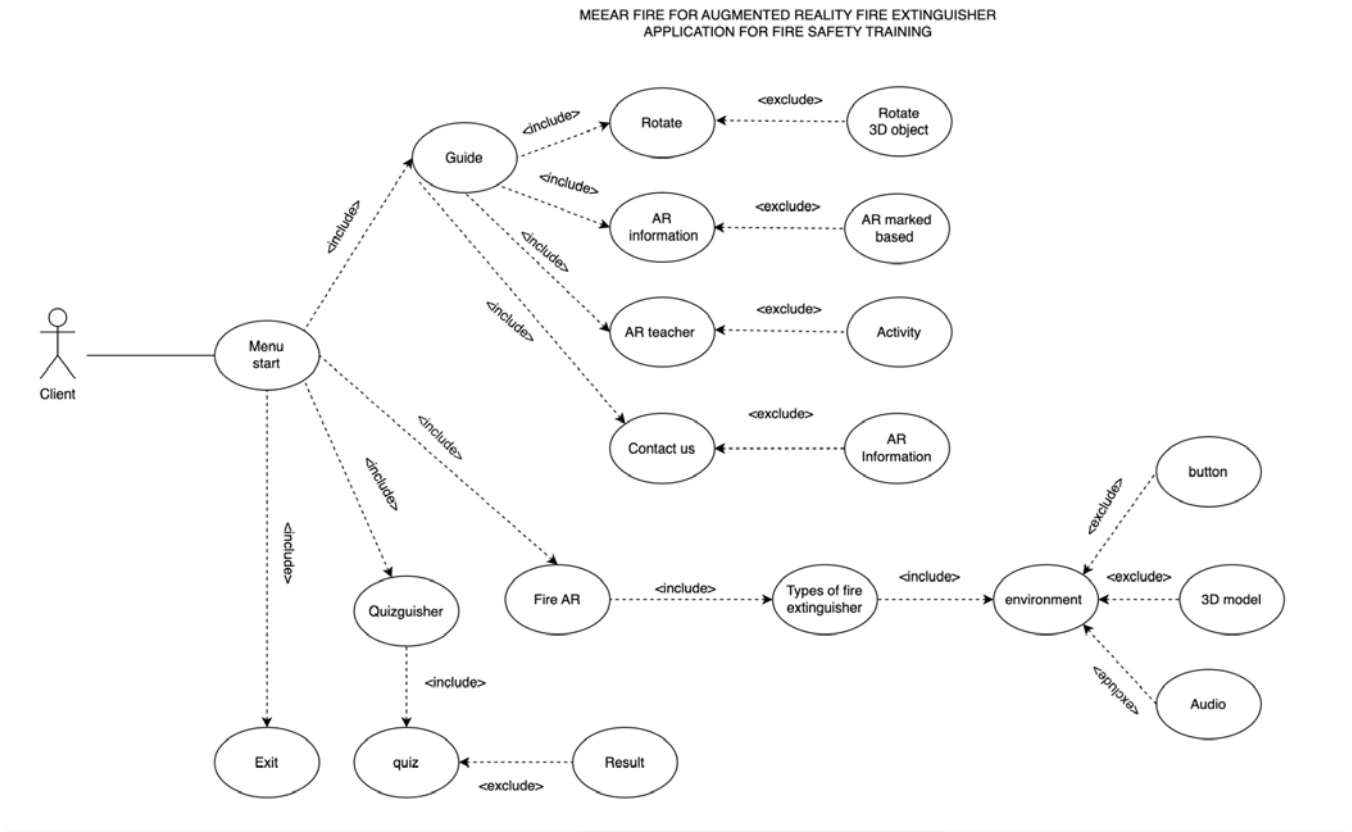


Figure 3.10: Use case diagram for the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE

Figure 3.10 shows the use case diagram of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE. The use case diagram contains a short detailed summary of the system's behaviour. Therefore, the use case diagram shows how the user interacts with the system completely. Moreover, the MeeAR FIRE system has a menu start that includes Guide, Fire AR, Quizguisher and Exit. These must be completely functional in order for the user to interact with other functions respectively. Next, the base environment is extended by a button, 3D model and audio which can be triggered as conditionally when the user only interacts with it.

3.10 FLOWCHART

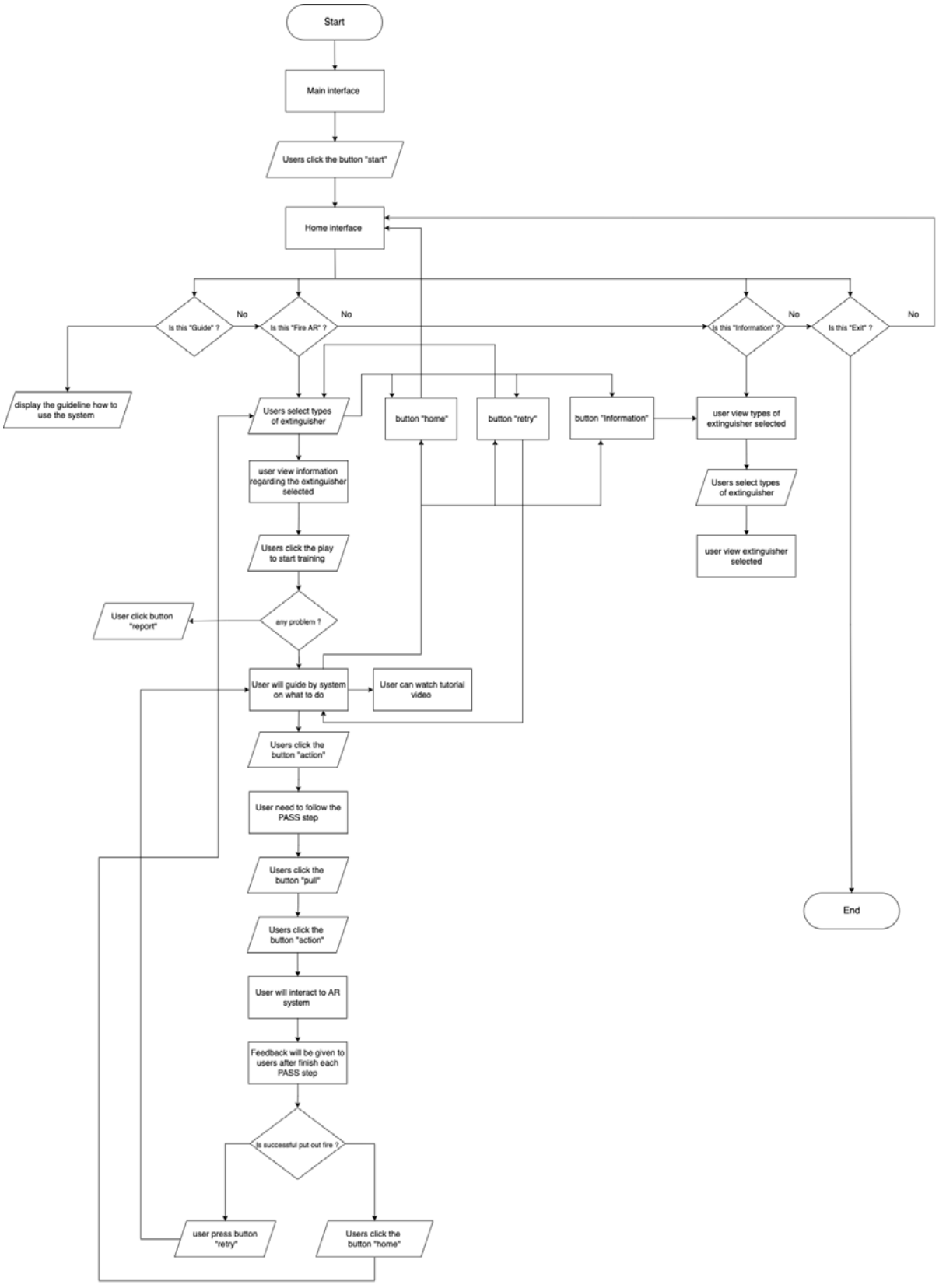


Figure 3.11 : Flowchart for the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE

Figure 3.11 is the flowchart of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE. The flowchart starts with the main interface. Therefore, the user needs to click the button “start” to go to the next scene with the home interface.

Moreover, in the home interface scene, there are 4(four) options buttons which are Guide, Fire AR, Quizguisher, and Exit. Each of them has different functionalities. For Guide options, it displays the guideline on how to use the system respectively.

Then, for Fire AR, the user needs to select the types of fire extinguishers in order to display the information regarding the extinguishers selected. Furthermore, the user needs to click the play button to start the training. There are user guidelines to help people explore the application. Therefore, if the user has had any problem with such a button, not functioning, the user can click the button report. Thus, in training mode, the user needs to follow the instructions wisely and follow the PASS step in order to complete the training. Next, the user needs to click the pull button to pull in the pin of the fire extinguisher and then click the action button to squeeze the components to put out the fire. Therefore, feedback will be given to the user after finishing each of the PASS steps. Next, at the end of the training, the system will ask the user whether they want to retry or back to the home Fire AR.

Hence, the information scene viewed the user of the types of extinguishers. Users need to select each of them to read the information about their selected extinguisher. Therefore, for the exit button, there are no and yes options which say the user will leave the system and for no user will return to the home scene.

3.11 ACTIVITY DIAGRAM

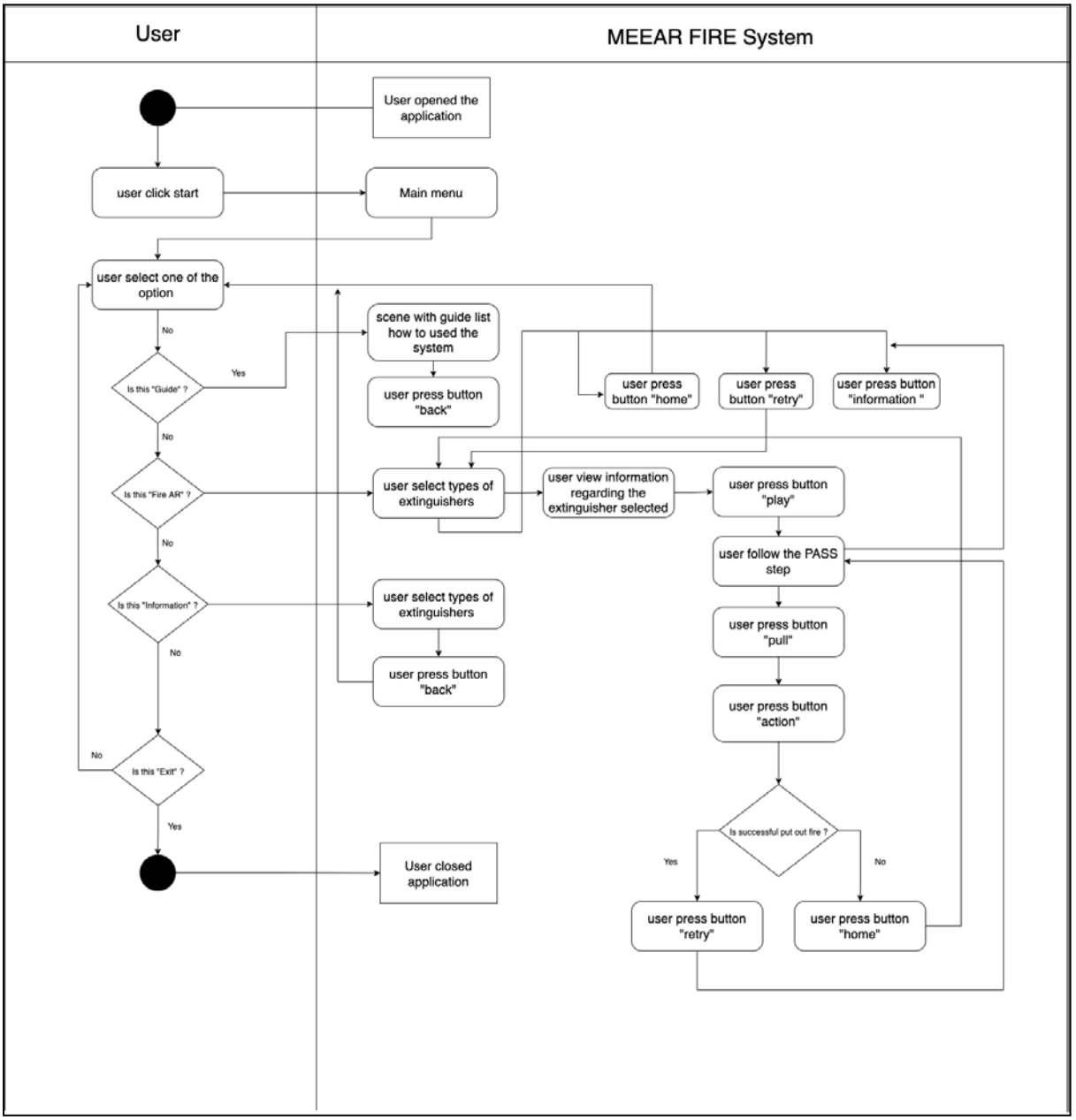


Figure 3.12: Activity diagram for the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE

Figure 3.12 is the activity diagram of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE. The activity diagram contains the user and MeeAR FIRE system behaviour. The activity starts with the user clicking the button

“start” and next goes to the main menu. Thus, users need to select each option from Guide, Fire AR, Information, and Exit in order to interact with the system.

3.12 DATA DESIGN

Table 3.5: Data design for welcome main

Welcome main	
Field name	**Description**
Start : UiButton	Start the AR room

Table 3.6: Data design for main menu

Main menu	
Field name	**Description**
Guide : UiButton	Guide user how to use the AR
Fire AR : UiButton	AR component for training and knowledge
Information : UiButton	Knowledge to the user about fire extinguisher
Exit : UiButton	Way out to the AR room

Table 3.7: Data design for guide

Guide	
Field name	**Description**
Back : UiButton	Back to previous scene

Table 3.8: Data design for exit

Exit	
Field name	**Description**
Yes : UiButton	Allow user to go out to the AR room
No : UiButton	Turn back to the home scene

Table 3.9: Data design for Fire AR

Fire AR	
Field name	**Description**
Home : UiButton	There are a few options in the home scene
Retry : UiButton	Allow user to retry the Fire AR room
Information : UiButton	Give user information about fire extinguisher
Setting : UiButton	Set up the audio
Fire extinguisher : Image	Visualize the content
Object 3D : GameObject	Visualize the content
Types extinguisher : UiButton	Allow user to choose different type of extinguisher
Camera : ARCamera	Display the component in cloud database
Play : UiButton	Go to training based
OK : UiButton	User wants the AR to act
Pull : UiButton	Pull the pin in training mode
Action : UiButton	Squeeze the fire extinguisher
Tutorial : UiButton	Allow to watch a video
Preview : Video	Watch a video
Go Next : UiButton	User wants the AR to act
Action : UiButton	User wants the AR to act
Report : UiButton	Allow user to send the bugs to developer
Back : UiButton	Back to the previous scene

3.13 PROPOSE DESIGN

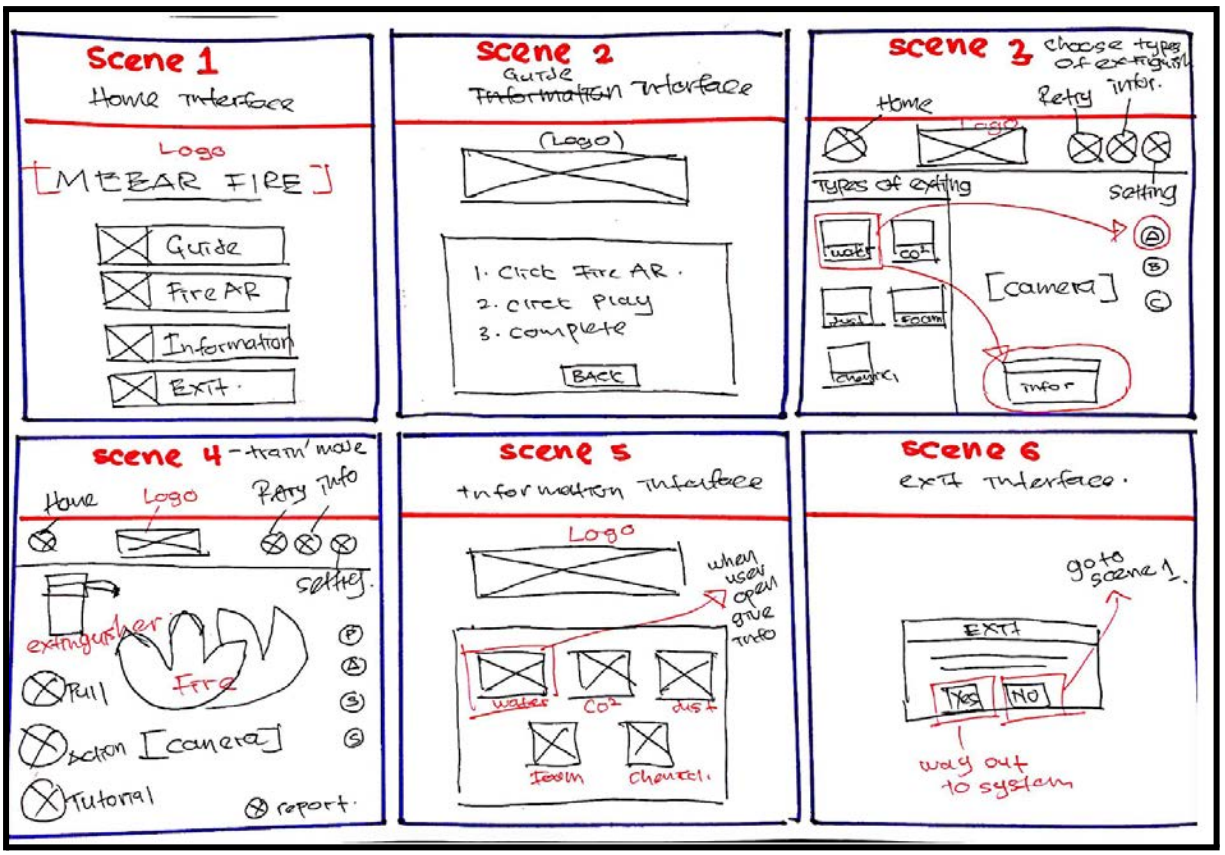


Figure 3.13 : The storyboard of MeeAR FIRE AR system

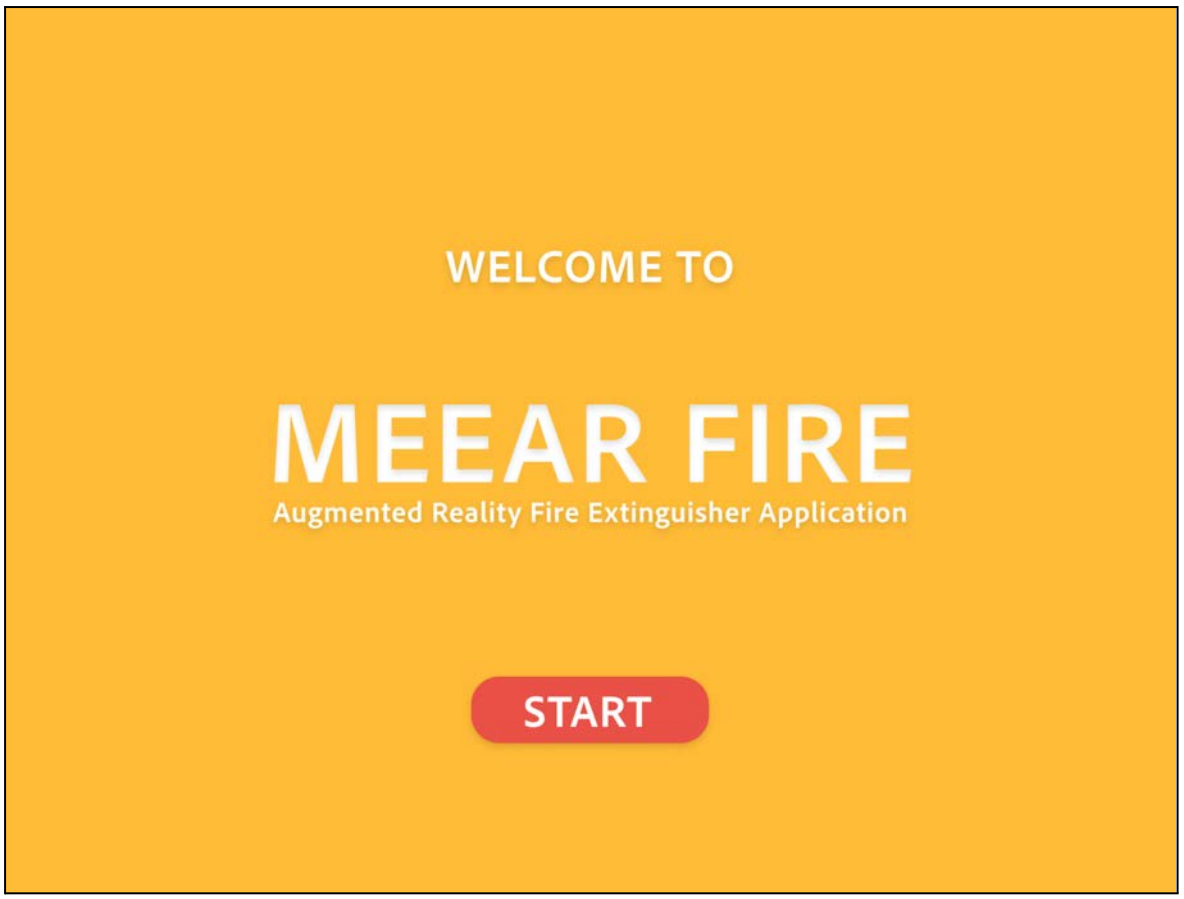


Figure 3.14: The interface of the MeeAR FIRE AR system

Figure 3.14 above shows the interface of the MeeAR FIRE augmented reality system after the user launches the application. Therefore, the user needs to click the start button to go to the next scene.

Figure 3.15 : The home interface of the MeeAR FIRE AR system

Figure 3.15 above shows the home interface of the MeeAR FIRE augmented reality system after the user clicks the start button. There are 4 options which are a guide, fire AR, information and an exit button.

Figure 3.16: The guided interface of the MeeAR FIRE AR system

Figure 3.16 above shows the guide interface of the MeeAR FIRE augmented reality system after the user clicks the button “guide”. Therefore, users can gain an idea of how to use the system. Users are able to go to the previous scene to opt for any type of fire extinguisher by clicking the button “back”.

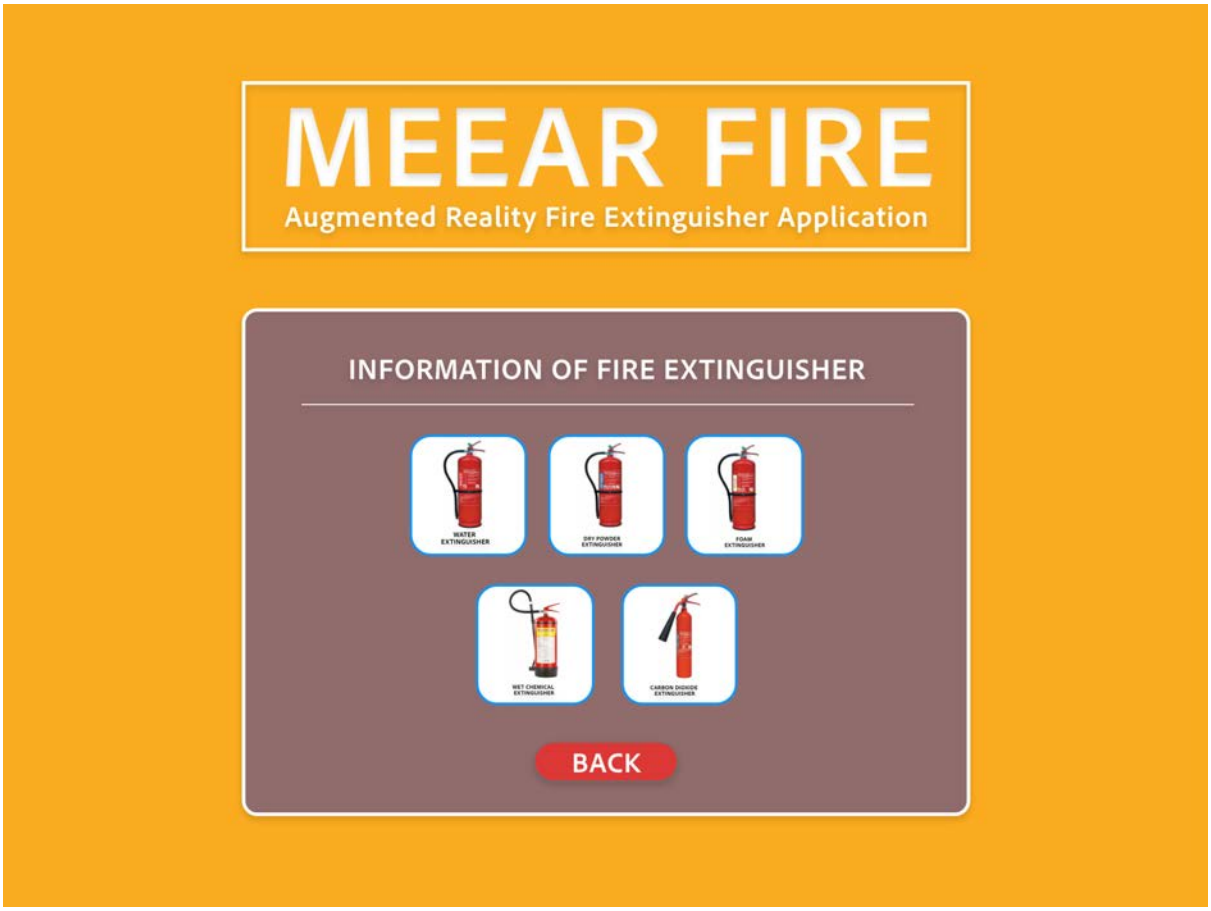


Figure 3.17 : The information interface of the MeeAR FIRE AR system

Figure 3.17 above shows the information interface of the MeeAR FIRE augmented reality system after the user clicks the information button. There are 5 types of options representative of fire extinguishers. Therefore, users can opt for each to read and gain knowledge.

Figure 3.18: The details inside the information interface of the MeeAR FIRE AR system

Figure 3.18 above shows the details inside the information interface of the MeeAR FIRE augmented reality system. Users are able to go to the previous scene to opt for any type of fire extinguisher by clicking the button “back”.

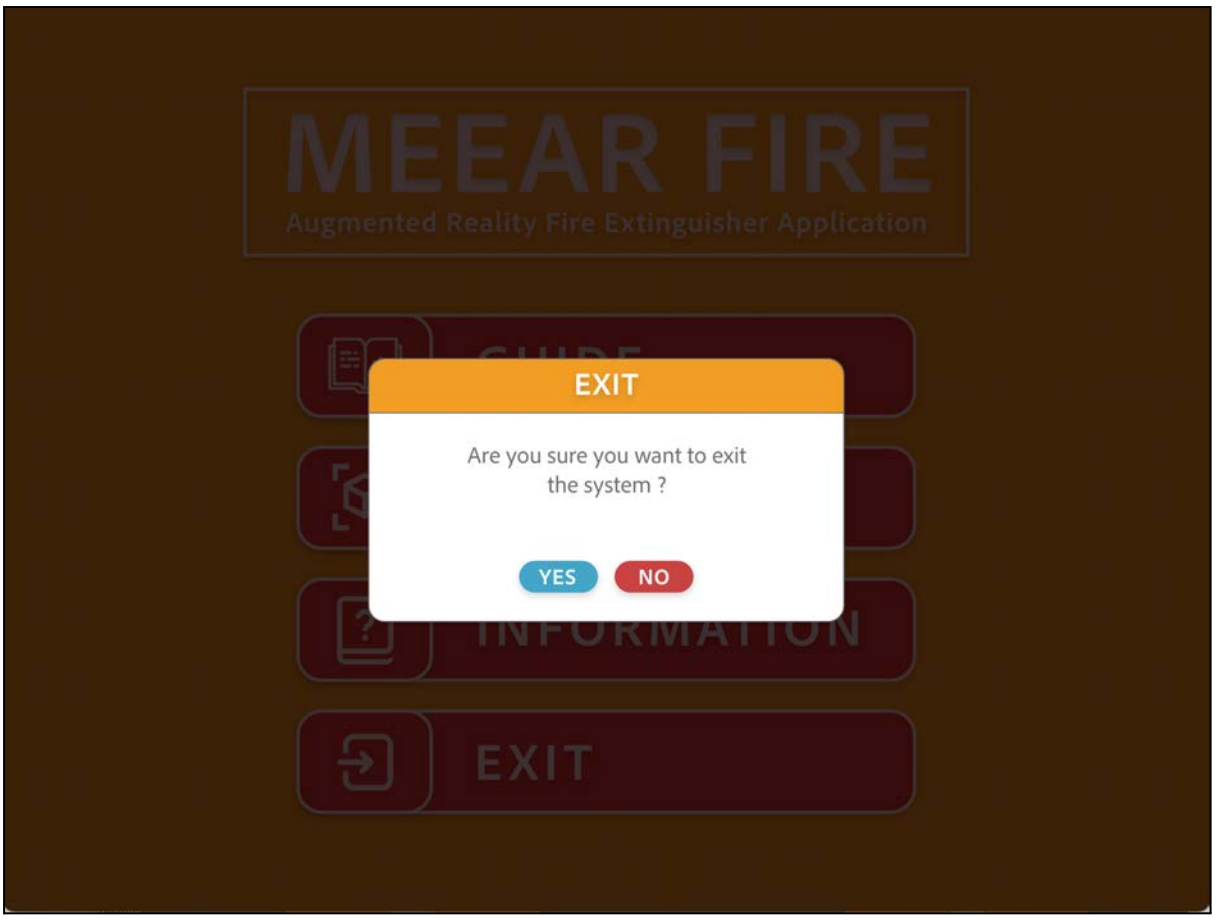


Figure 3.19: The exit alert of the MeeAR FIRE AR system

Figure 3.19 above shows the exit alert of the MeeAR FIRE augmented reality system after the user clicks the button “Exit” at the home interface. Therefore, there are conditions between yes and no, if yes they quit a way from the application or else go back to the home interface application.

Figure 3.20: The information interface of the MeeAR FIRE AR system

Figure 3.20 above shows the information interface of the MeeAR FIRE augmented reality system after the user clicks the information button. There are 5 types of options representative of fire extinguishers. Therefore, users can opt for each to read and gain knowledge.

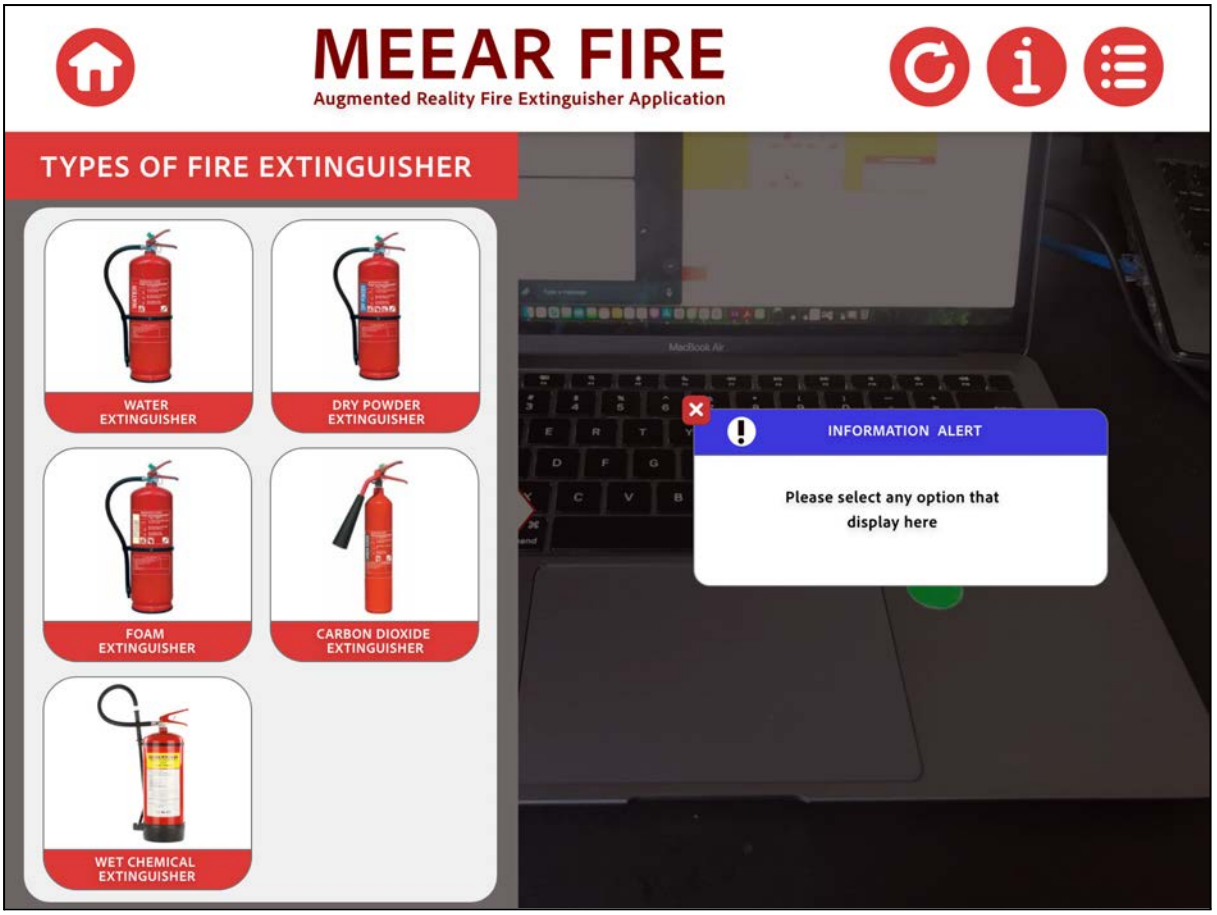


Figure 3.21: The select types of fire extinguishers of the MeeAR FIRE AR system

Figure 3.21 above shows the information alert of the MeeAR FIRE augmented reality system pop-up to guide users. Therefore, the user needs to select any option types of fire extinguishers displayed on the left screen.

Figure 3.22: The options water of extinguisher has selected

Figure 3.22 above shows the options that have been selected which water extinguisher. Thus, user feedback has been highlighted with blue light colour addressed as choosing.

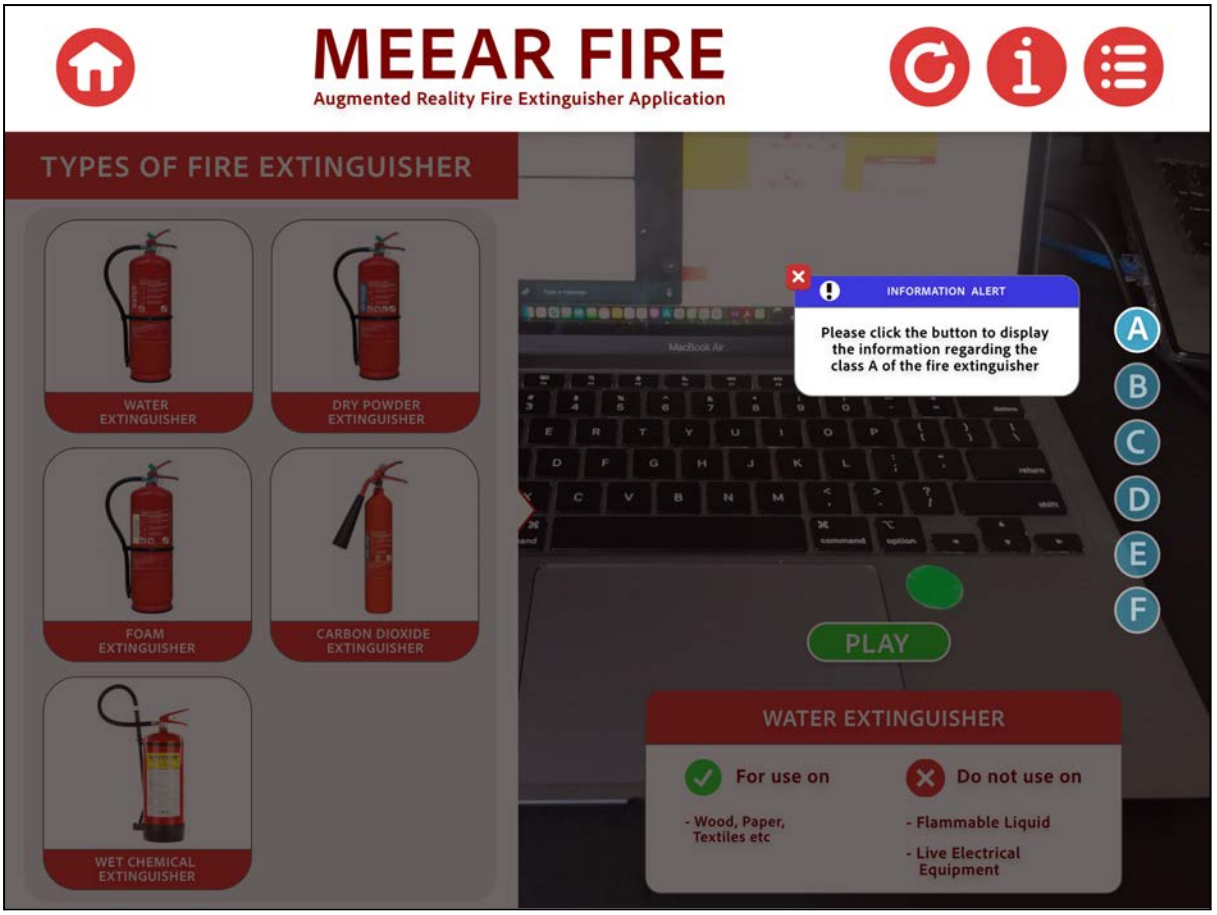


Figure 3.23: An information alert has appeared on the display.

Figure 3.23 above shows the information alert displayed in order to guide the user on how to use the system.

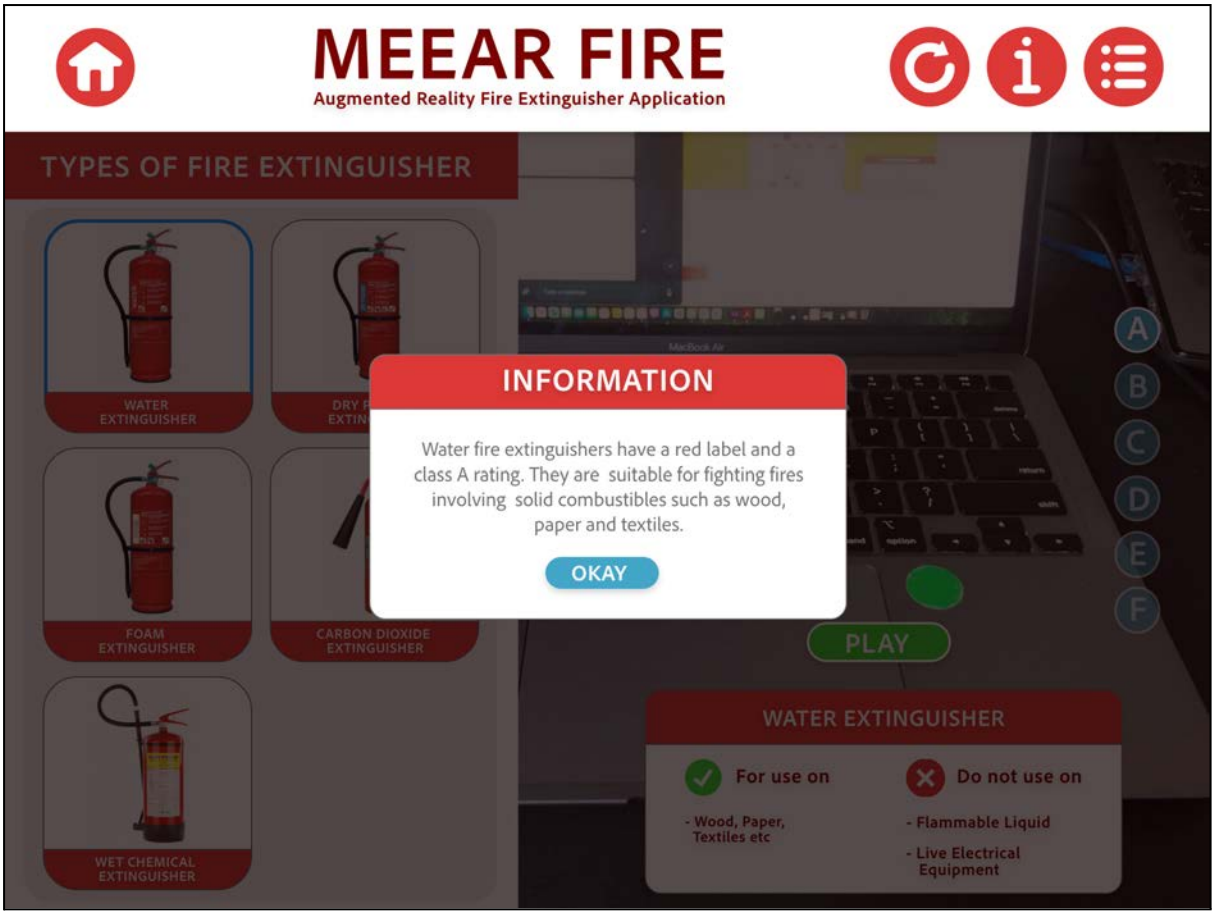


Figure 3.24: The general knowledge is displayed.

Figure 3.24 above shows the general knowledge displayed after the user clicks the button “A”. User needs to click okay to go back to the interface.

Figure 3.25: An information alert is displayed on the screen.

Figure 3.25 above shows the information alert appearing on the display which needs the user to click the PLAY button to explore the scene of training.

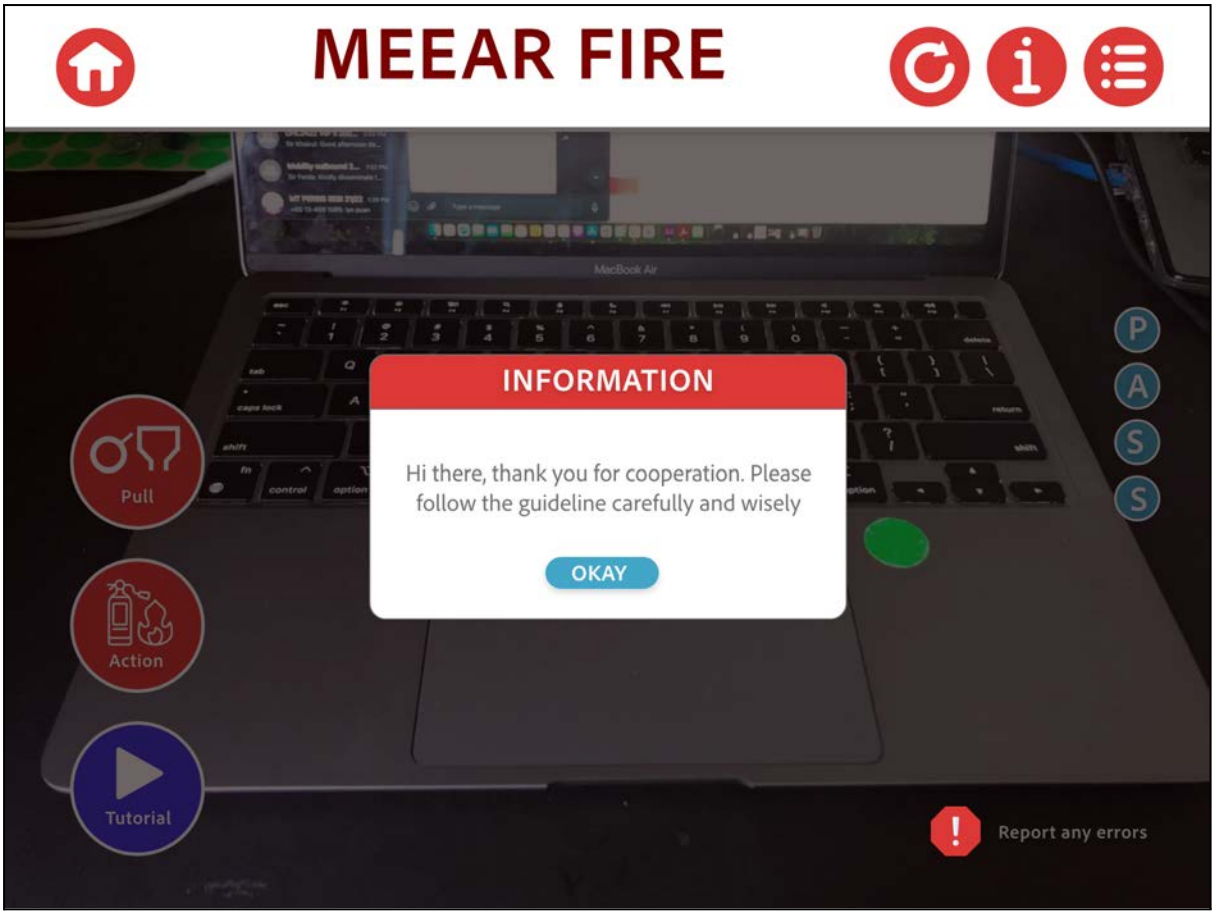


Figure 3.26: The short instructions are visible on the display.

Figure 3.26 above shows the brief instruction that appears on the screen. The user needs to click the button “OKAY” to go to the next action.

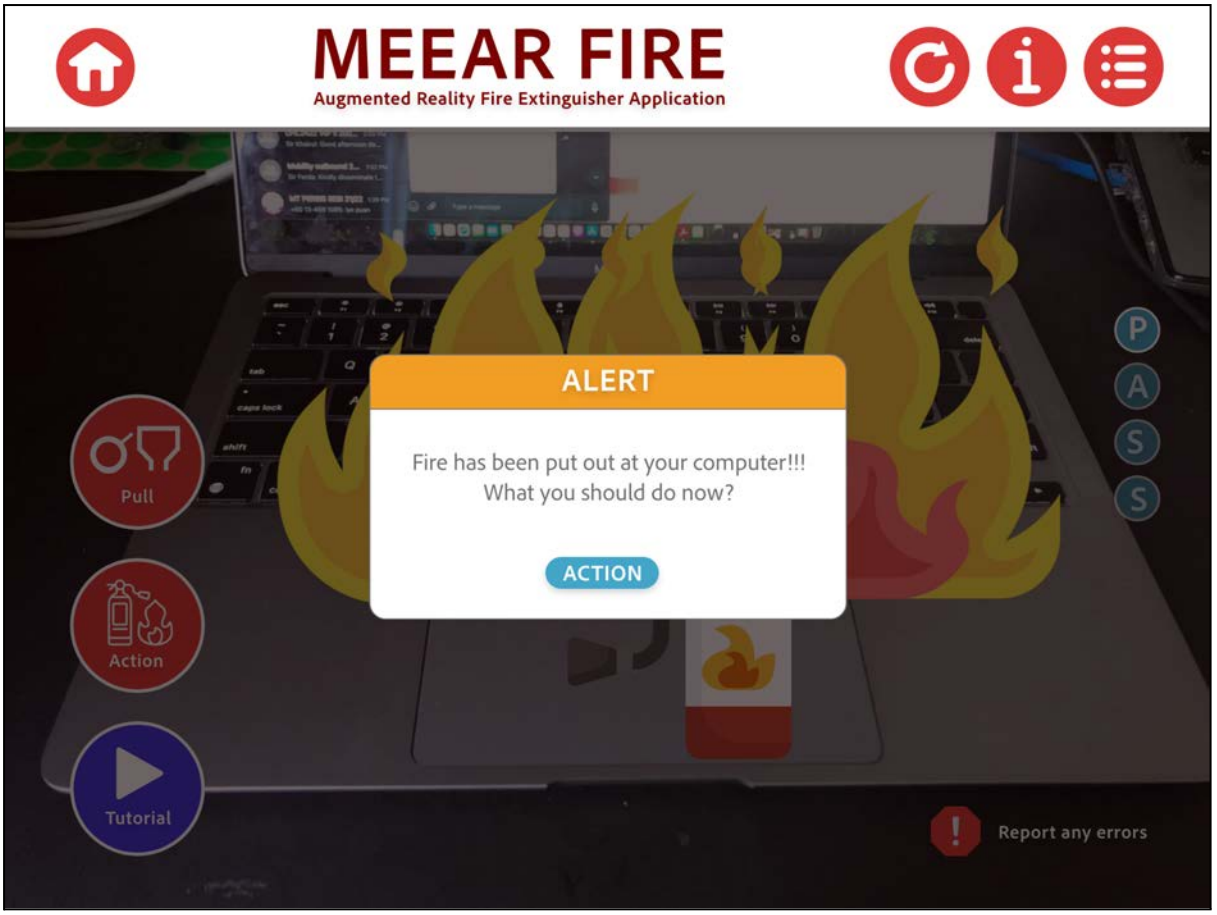


Figure 3.27: The alert appears on the screen

Figure 3.27 above shows the alert box that appears on the screen that needs the user takes action regarding the situation that happened.

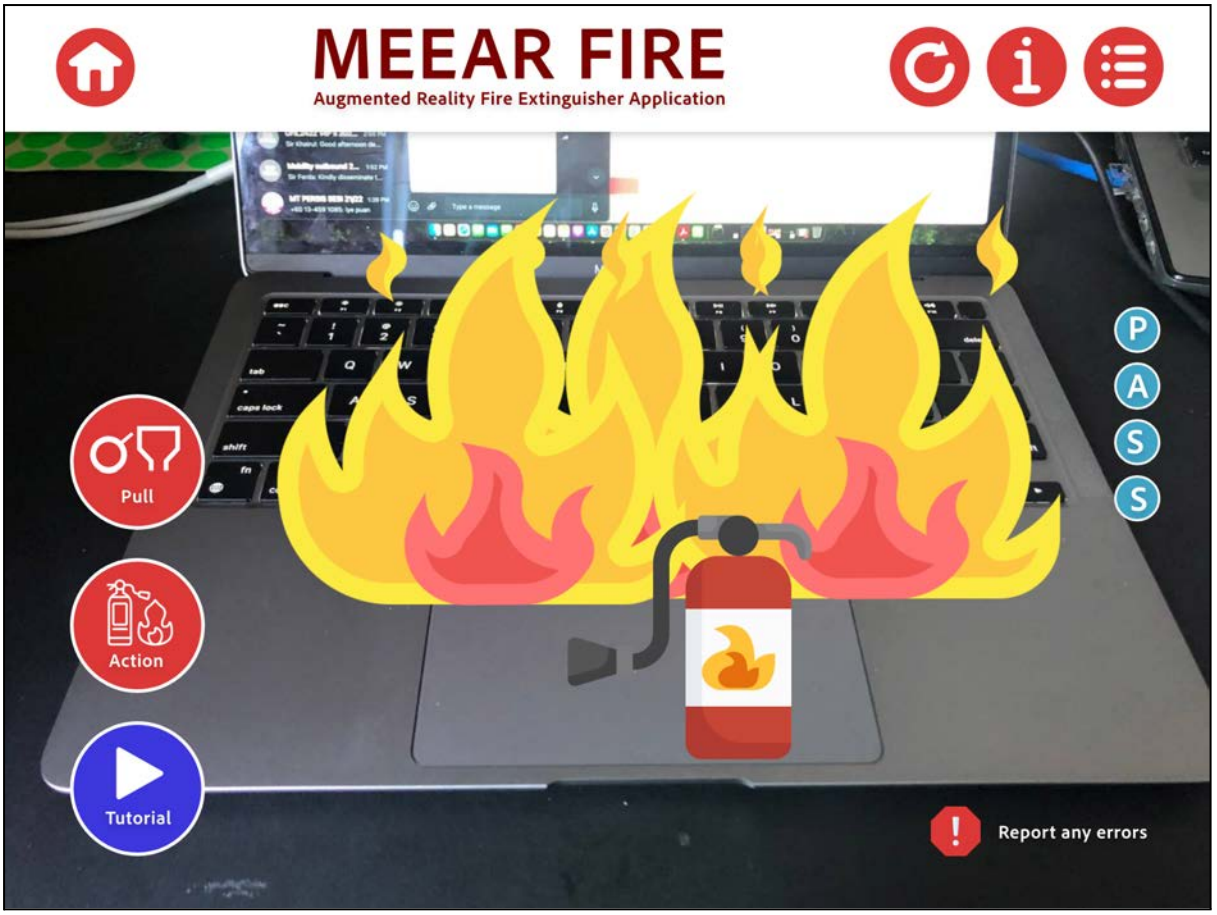


Figure 3.28: The interface of the training mode

Figure 3.28 above shows the interface of the training mode which displays real-time situations. The AR system is based on markless that does not require any trigger detection to overlay virtual 3D to the screen.

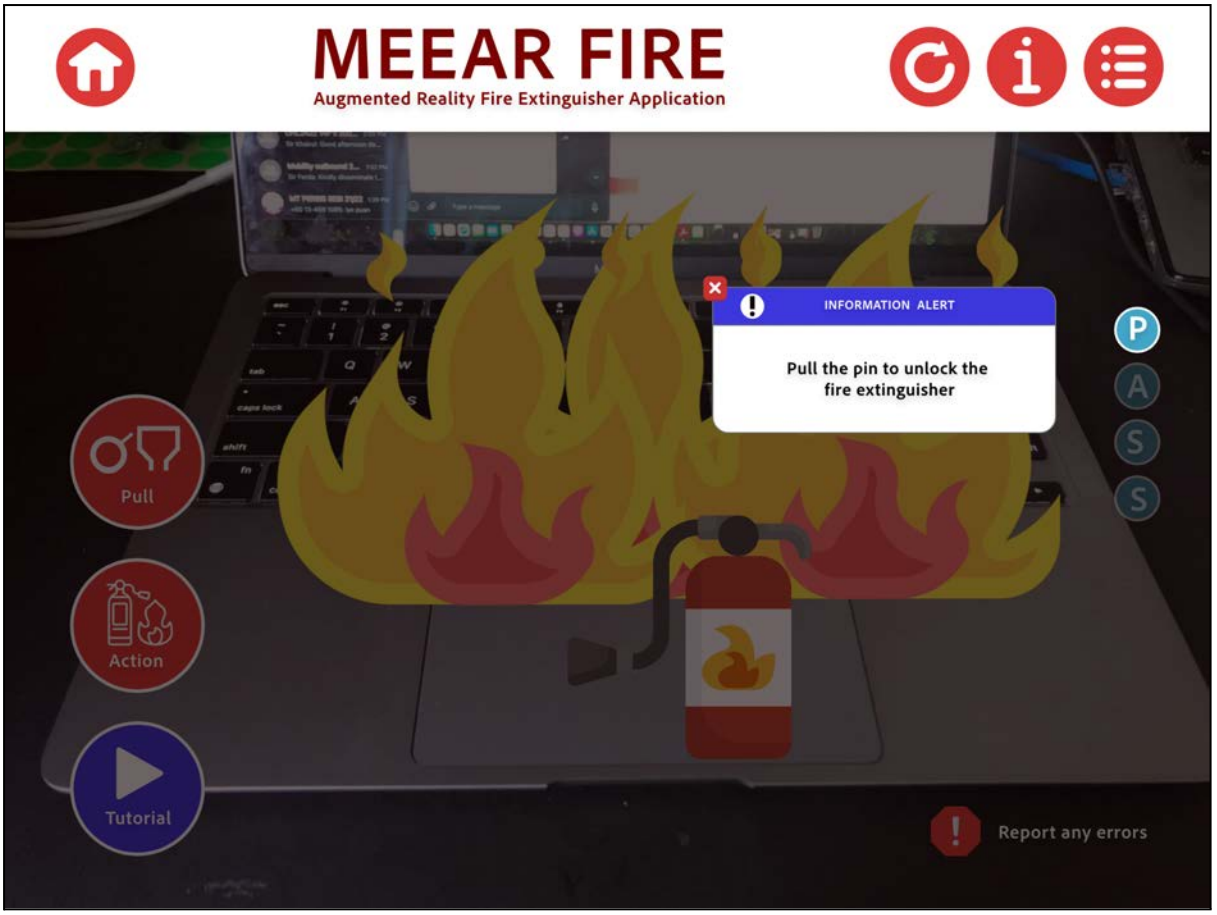


Figure 3.29: The information alert to guide the user

Figure 3.29 above shows the information alert to guide the user on how the training work.

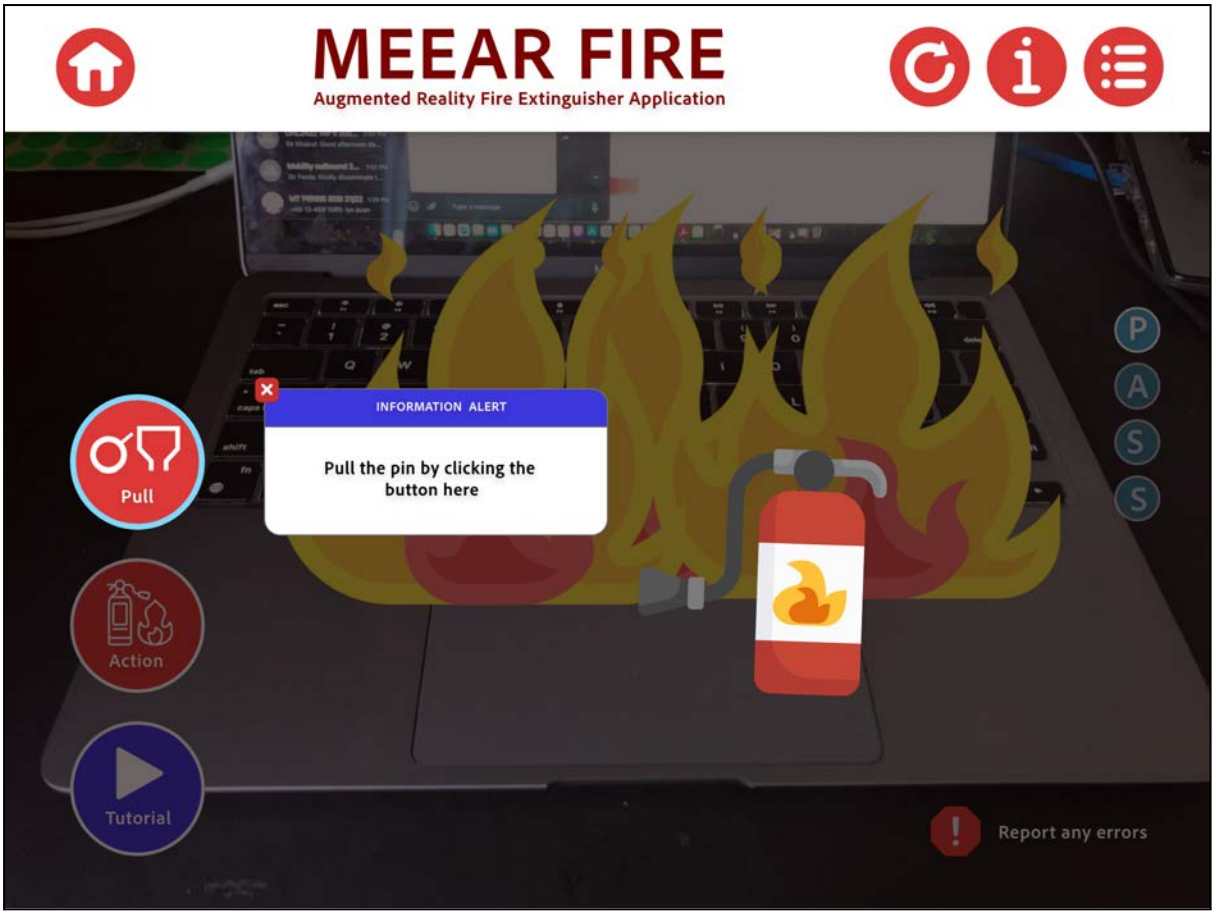


Figure 3.30: The information alert to guide the user

Figure 3.30 above shows the information alert to guide the user on how the training work. Users need to pull the pin by clicking the button “pull”.

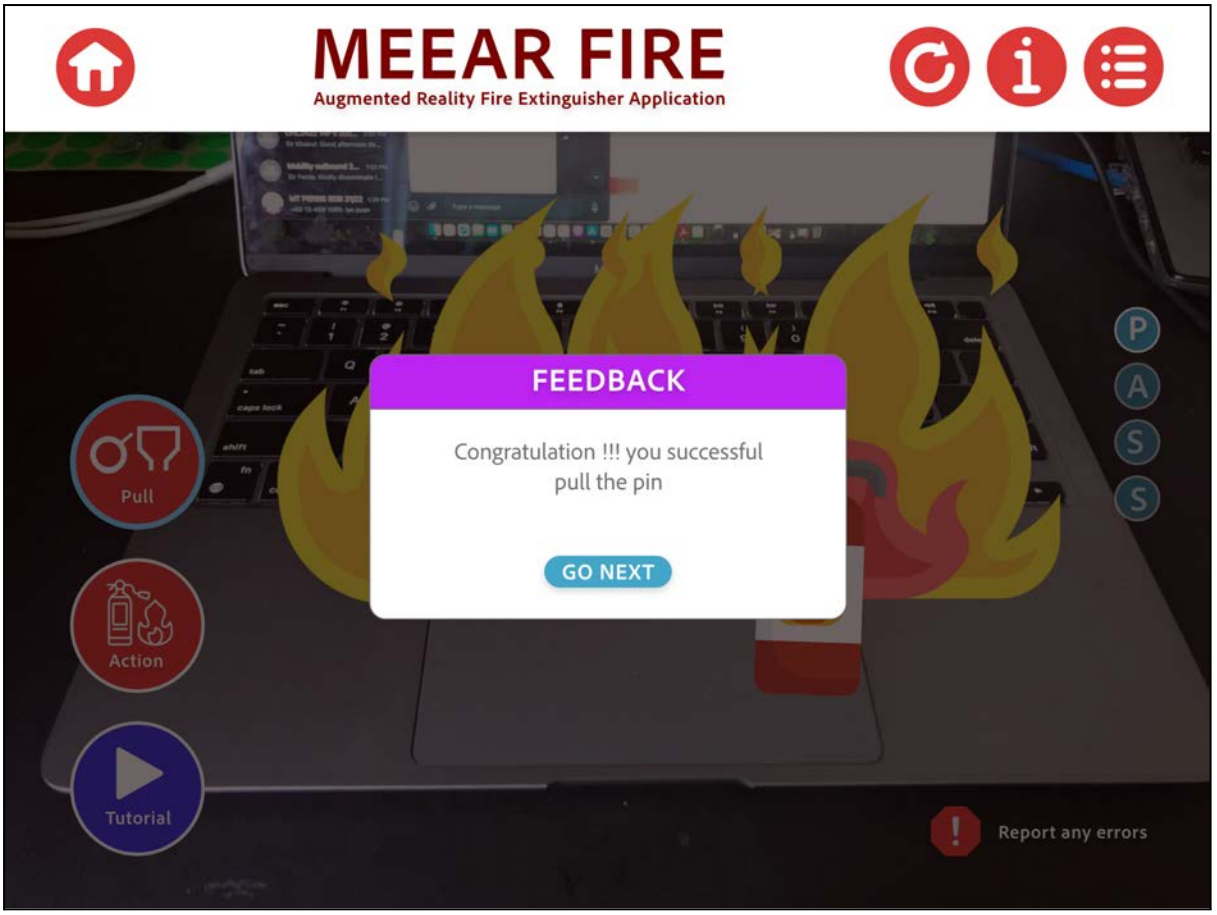


Figure 3.31: The feedback box appear after the user is done for each PASS step

Figure 3.31 above shows the feedback box appears after the user is done for each PASS step. The user needs to click go next to do the next step until puts out the fire.

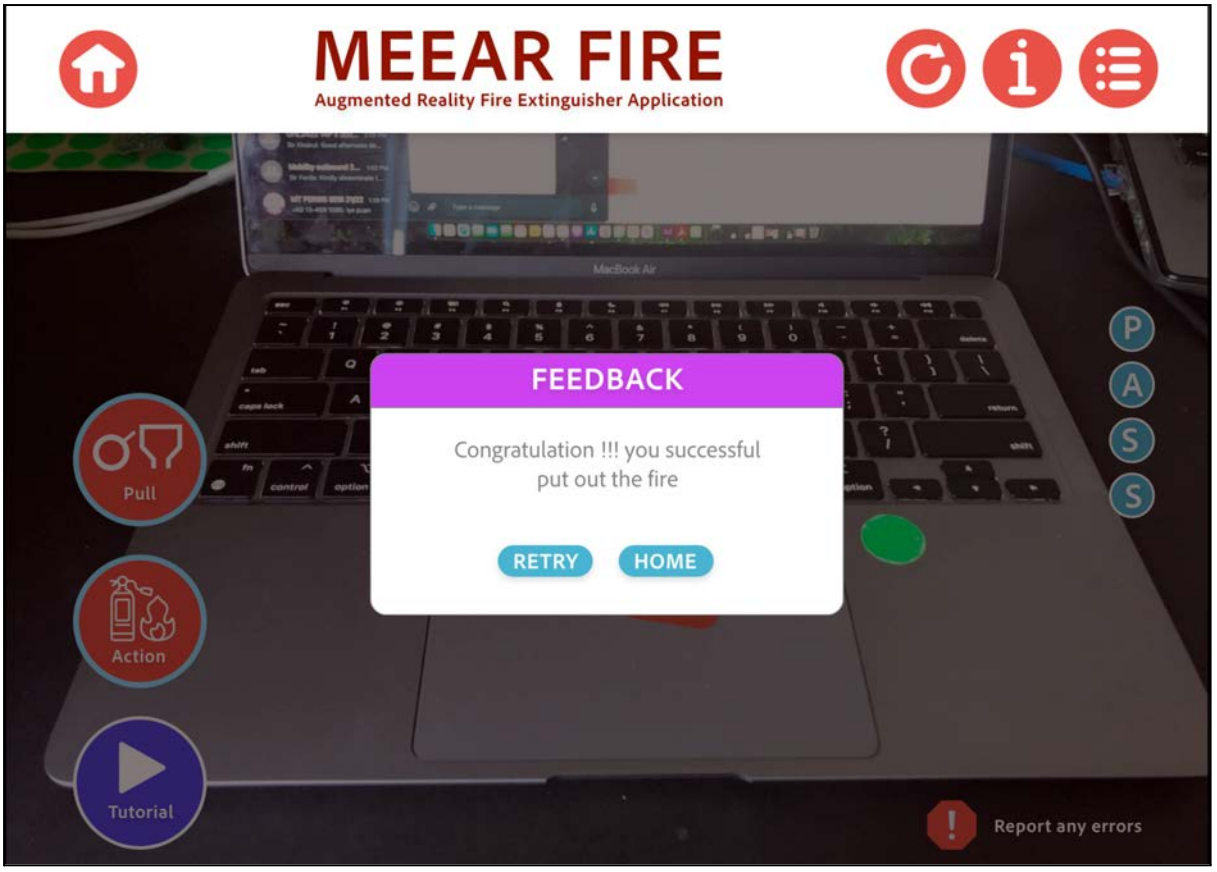


Figure 3.32: After completing all the steps in PASS, a feedback box will appear for the user.

Figure 3.32 above shows the feedback box appearing after the user has done all of the PASS steps. Users can click retry to go to the training mode scene at the beginning or can click home to go to the types of extinguisher scene.

3.14 PLANNING FOR IMPLEMENTATION AND TESTING

Testing performance involves the client and end-user that validate the end workflow and whether it accepts the criteria and expected result of the Augmented Reality Fire Extinguisher Application for Fire Safety Training system. Therefore, using the testing we can communicate all the features of the system built and detect any minor error attempts. Also, it will observe the entire system that can be required changed in further development.

FUNCTIONALITY ACCEPTANCE TESTING (FAT) **AUGMENTED REALITY FIRE EXTINGUISHER APPLICATION FOR FIRE SAFETY TRAINING**							
Client Name: **Phone Number:** **Email:**						**Date:**	
No.	**ID**	**Acceptance Criteria**	**Expectation Result**	**Actual Result**	**Pass / Fail**	**Inspection Type**	**Remarks**
1.	ARFX001	3D model appears at display					
2.	ARFX002	Interactive audio display					
3.	ARFX003						
4.	ARFX005						
5.	ARFX006						
6.	ARFX007						

For inspection type: E-excellent, A-average, P-poor

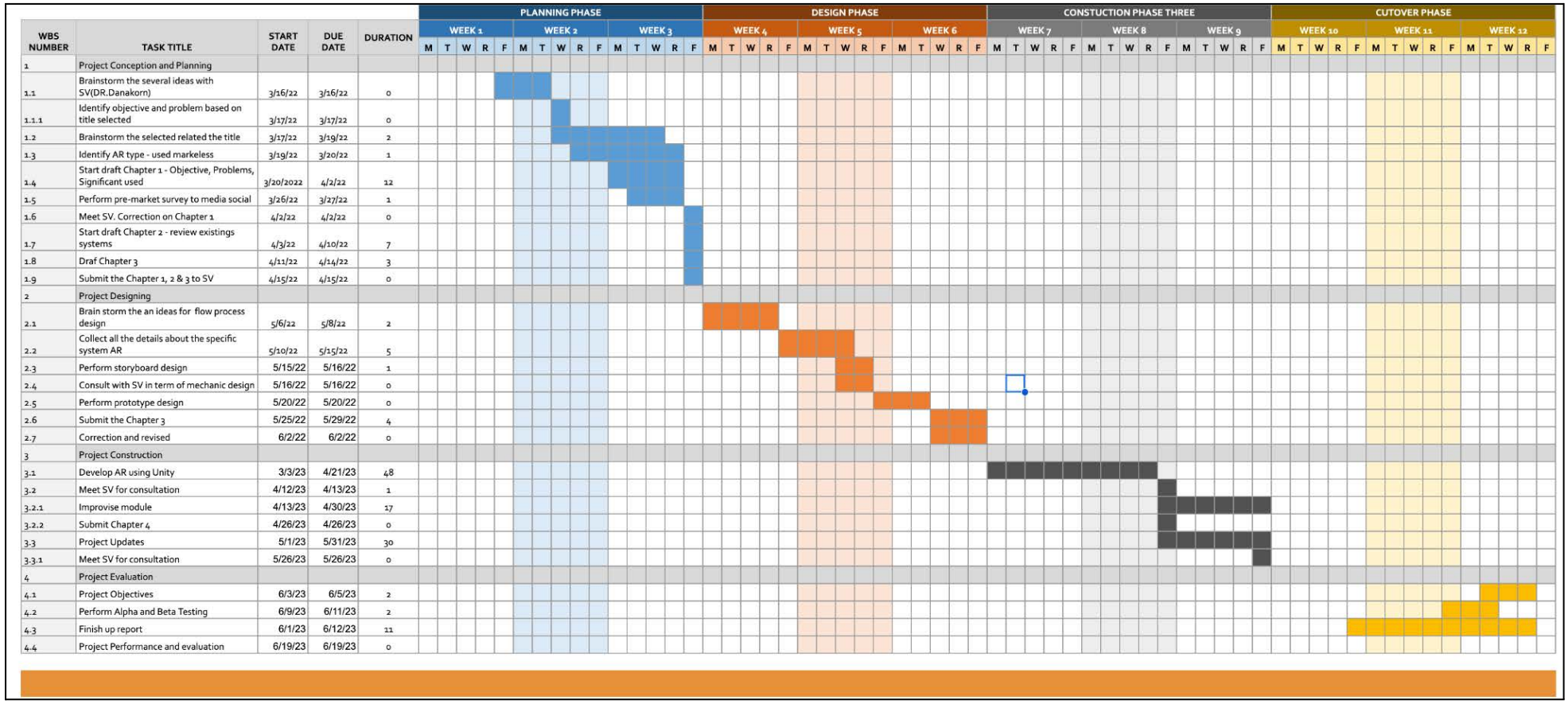
USER ACCEPTANCE TESTING (UAT)
AUGMENTED REALITY FIRE EXTINGUISHER APPLICATION FOR FIRE SAFETY TRAINING

Client Name: **Phone Number:** **Email:** **Date:**	**Date:**

No.	ID	Acceptance Criteria	Pass / Fail	Inspection Type	Remarks
1.	FRFX001	Correspondence on device			
2.	FRFX002	Display the audio perfectly			
3.	FRFX003	Correspondence next scene			
4.	FRFX005	Size of the system			
5.	FRFX006				
6.	FRFX007				

For inspection type: E-excellent, A-average, P-poor

3.15 GANTT CHART



WBS NUMBER	TASK TITLE	START DATE	DUE DATE	DURATION
1	Project Conception and Planning			
1.1	Brainstorm the several ideas with SV(DR.Danakorn)	3/16/22	3/16/22	0
1.1.1	Identify objective and problem based on title selected	3/17/22	3/17/22	0
1.2	Brainstorm the selected related the title	3/17/22	3/19/22	2
1.3	Identify AR type - used markeless	3/19/22	3/20/22	1
1.4	Start draft Chapter 1 - Objective, Problems, Significant used	3/20/2022	4/2/22	12
1.5	Perform pre-market survey to media social	3/26/22	3/27/22	1
1.6	Meet SV. Correction on Chapter 1	4/2/22	4/2/22	0
1.7	Start draft Chapter 2 - review existings systems	4/3/22	4/10/22	7
1.8	Draf Chapter 3	4/11/22	4/14/22	3
1.9	Submit the Chapter 1, 2 & 3 to SV	4/15/22	4/15/22	0
2	Project Designing			
2.1	Brain storm the an ideas for flow process design	5/6/22	5/8/22	2
2.2	Collect all the details about the specific system AR	5/10/22	5/15/22	5
2.3	Perform storyboard design	5/15/22	5/16/22	1
2.4	Consult with SV in term of mechanic design	5/16/22	5/16/22	0
2.5	Perform prototype design	5/20/22	5/20/22	0
2.6	Submit the Chapter 3	5/25/22	5/29/22	4
2.7	Correction and revised	6/2/22	6/2/22	0
3	Project Construction			
3.1	Develop AR using Unity	3/3/23	4/21/23	48
3.2	Meet SV for consultation	4/12/23	4/13/23	1
3.2.1	Improvise module	4/13/23	4/30/23	17
3.2.2	Submit Chapter 4	4/26/23	4/26/23	0
3.3	Project Updates	5/1/23	5/31/23	30
3.3.1	Meet SV for consultation	5/26/23	5/26/23	0
4	Project Evaluation			
4.1	Project Objectives	6/3/23	6/5/23	2
4.2	Perform Alpha and Beta Testing	6/9/23	6/11/23	2
4.3	Finish up report	6/1/23	6/12/23	11
4.4	Project Performance and evaluation	6/19/23	6/19/23	0

PLANNING PHASE | DESIGN PHASE | CONSTUCTION PHASE THREE | CUTOVER PHASE

WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | WEEK 5 | WEEK 6 | WEEK 7 | WEEK 8 | WEEK 9 | WEEK 10 | WEEK 11 | WEEK 12

M T W R F

Here is a link for further review:
https://docs.google.com/spreadsheets/d/19Zd9ZcAC9uUw6TJO5cXuUAEwbvfdcix5z7hq_aCfaNc/edit?usp=sharing

3.16 POTENTIAL USED

Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE with the concept of the training for a safety fire extinguisher that helps people acknowledge their types. The content of the MeeAR FIRE AR system is aimed at all different kinds of people since knowing how to use fire extinguishers is a must because we do not realize what happened next

Augmented reality in training is interactive and contains digital elements of the real-world environment. This will benefit technical skills or multi-step tasks to be completed. The potential use of the system is for the company. They seem like they do not have time to do training consistently. Then, when using the MeeAR FIRE AR system will reduce the time and cost of the training. Therefore, at the same time, they gain knowledge about fire extinguishers better than traditional methods.

Next, another potential use is at school. Traditional classroom-based training requires expertise and also the material involved. It will mess up to handle in terms of the huge number of people involved. They do not pay attention well and drop their understanding of the extinguishers. Therefore, the outcome of learning will not pass the level. However, by using the MeeAR FIRE AR system students or teachers at school can attempt how much they want. Memorize the types of extinguishers and at the same time enjoy the multimedia content inside.

However, the MeeAR FIRE AR system has the potential to be a fire brigade. They can use this application to do the training for fire extinguishers just from their device. From the application, they can gain comprehension and understanding of the types of fire extinguishers that need to be used in different scenarios or situations. Furthermore, AR technology can help fire brigades classify how to use fire extinguishers, which can truly be a benefit to them and to others later on.

CHAPTER 4

IMPLEMENTATION AND TESTING

4.1 OVERVIEW

This chapter aims to discuss the implementation of the Augmented Reality Fire Extinguisher Application for Fire Safety Training. However, this chapter also will be discussed on the process and information. Furthermore, the steps and coding applied will be justified as the reasoning for each module. The testing method will be stated and the result discussion will be analysed. All the methods of getting results will be mentioned.

Augmented Reality Fire Extinguisher Application for Fire Safety Training is developed using Unity Engine and extended with C# language. Moreover, the product was enhanced together with the Vuforia database and a few User Interface designs were implemented.

Additionally, this chapter verifies and confirms the testing process and the results. The objective is to ensure the functionality and usability of the developed augmented reality fire extinguisher application for fire safety training by carrying out the testing phase to check whether the results from Augmented Reality Fire Extinguisher Application for Fire Safety Training meet the user demands and to identify bug or errors within the application and take necessary measures to correct these bugs before releasing or delivery to the user for use.

4.3 PROPOSED & DATA DESIGN

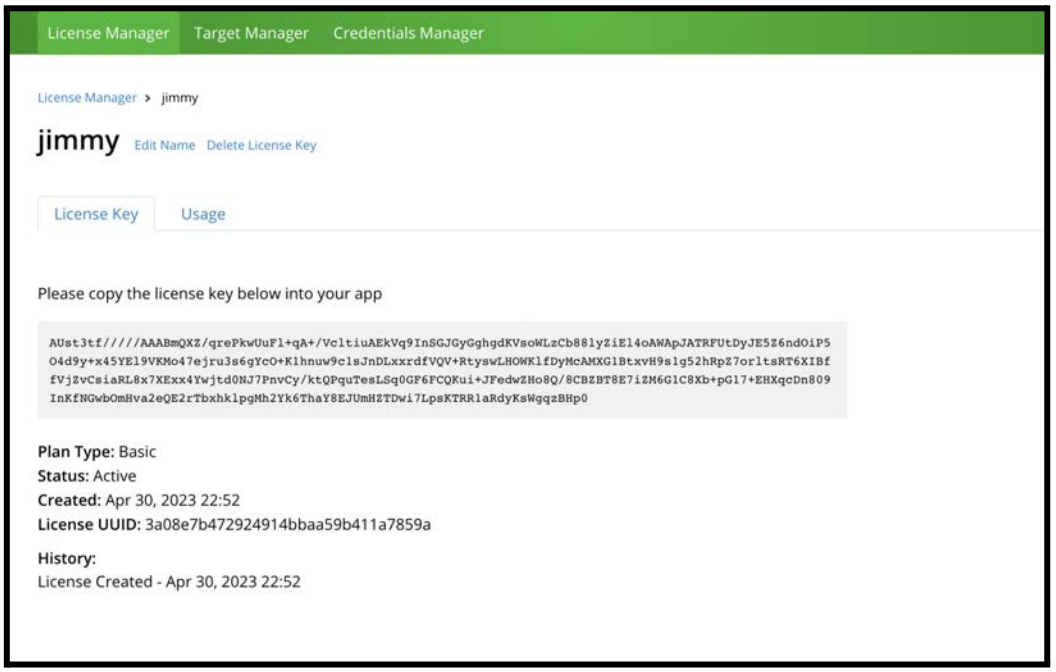


Figure 4.1: The licence manager by Vuforia

Figure 4.1 above shows the licence manager that Unity will use to develop the augmented reality for mark-based image tracking.

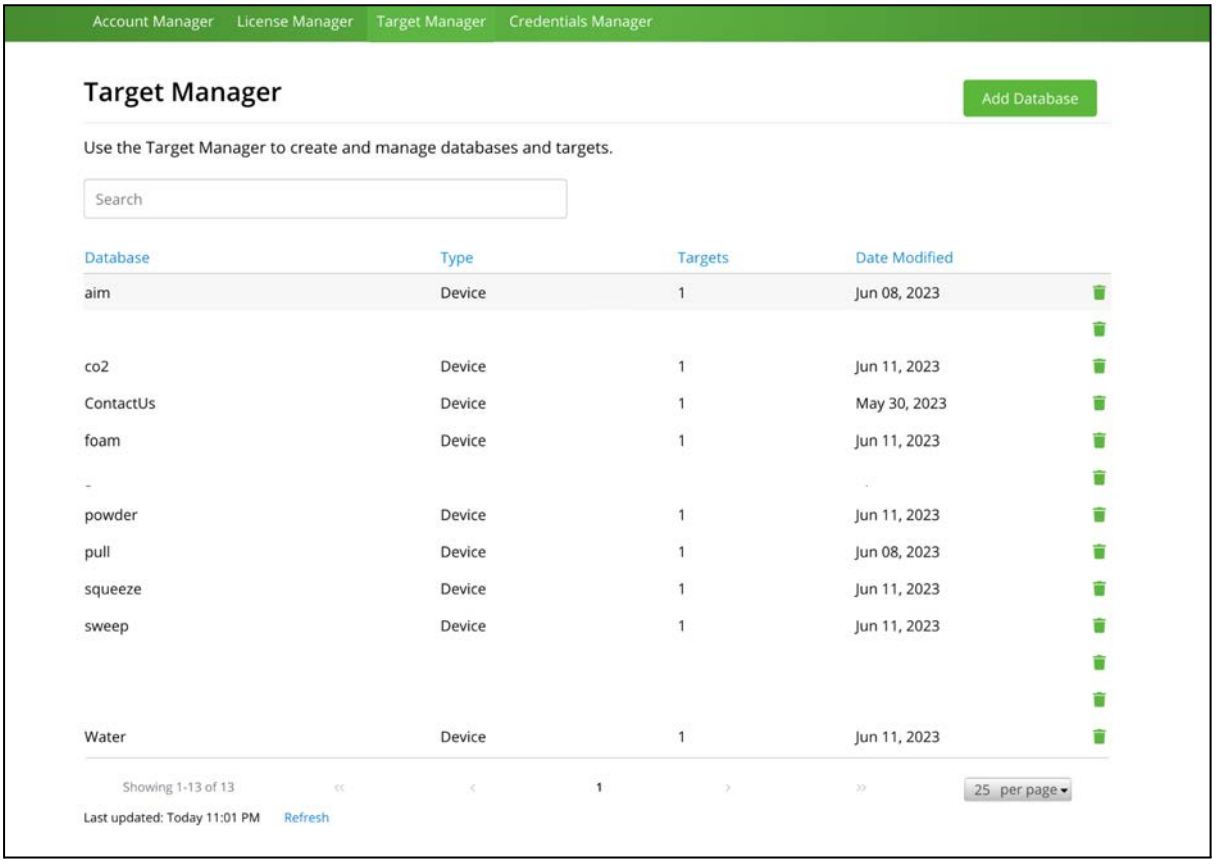
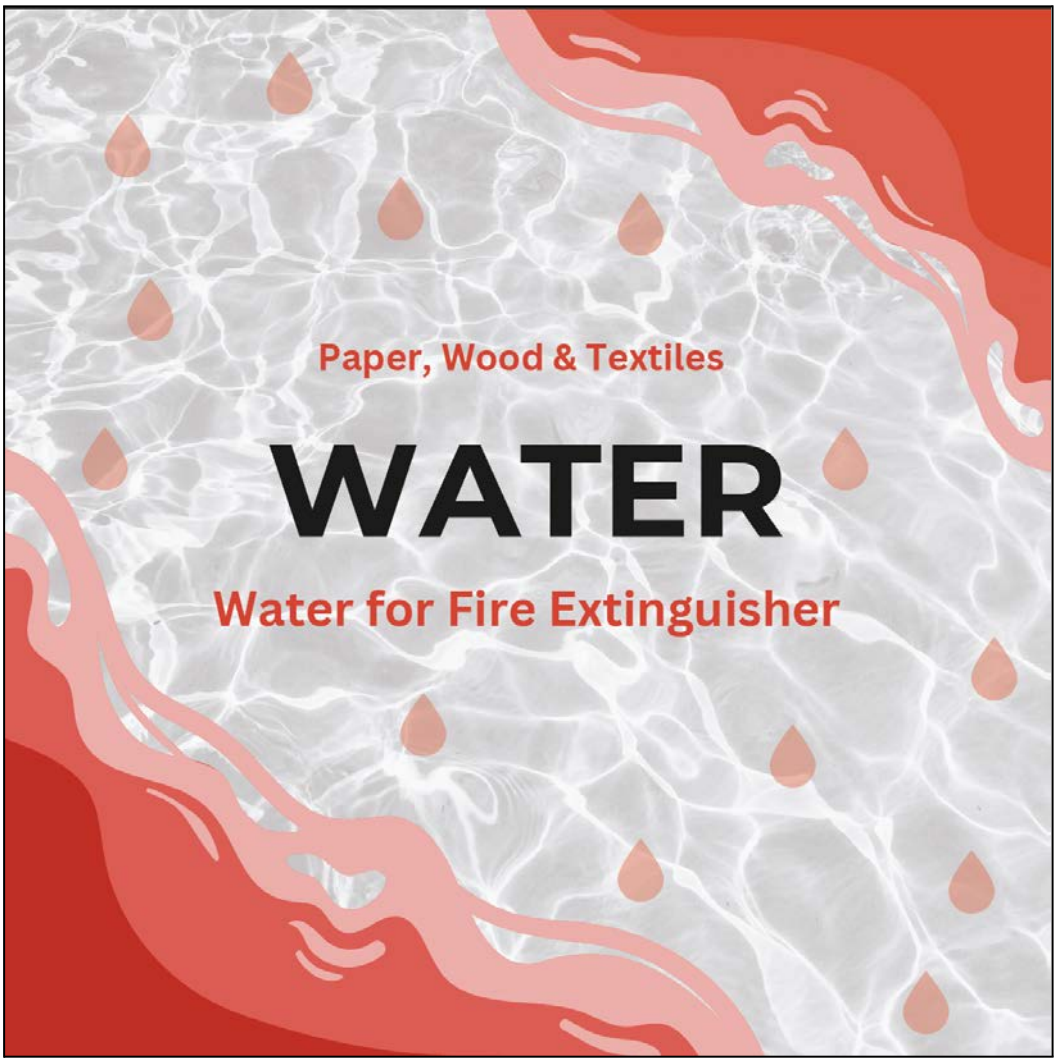


Figure 4.2: The target manager

The image above, labelled as Figure 4.2, displays the target manager for all image targets used in the entire project.

A. Image Tracking for Water fire extinguisher category



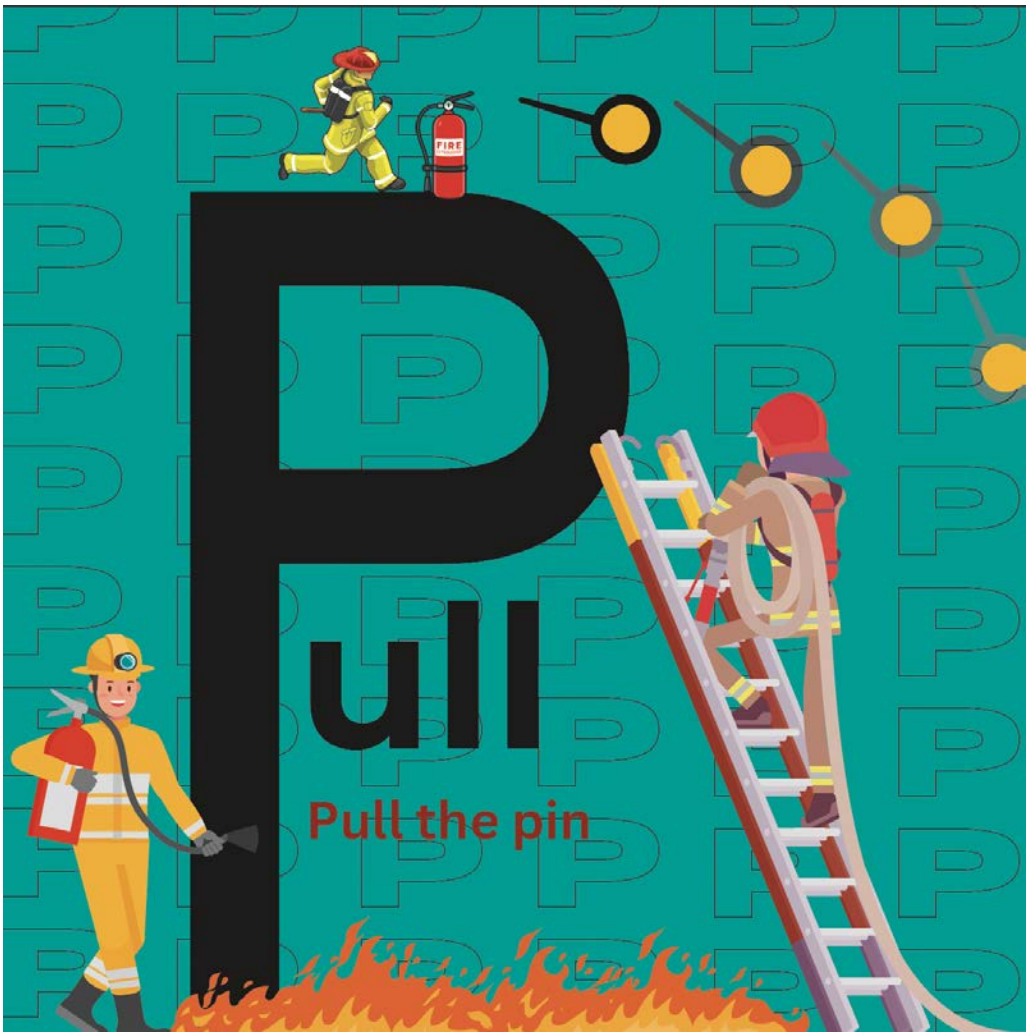
B. Image Tracking for Carbon Dioxide fire extinguisher category

C. Image Tracking for Foam fire extinguisher category

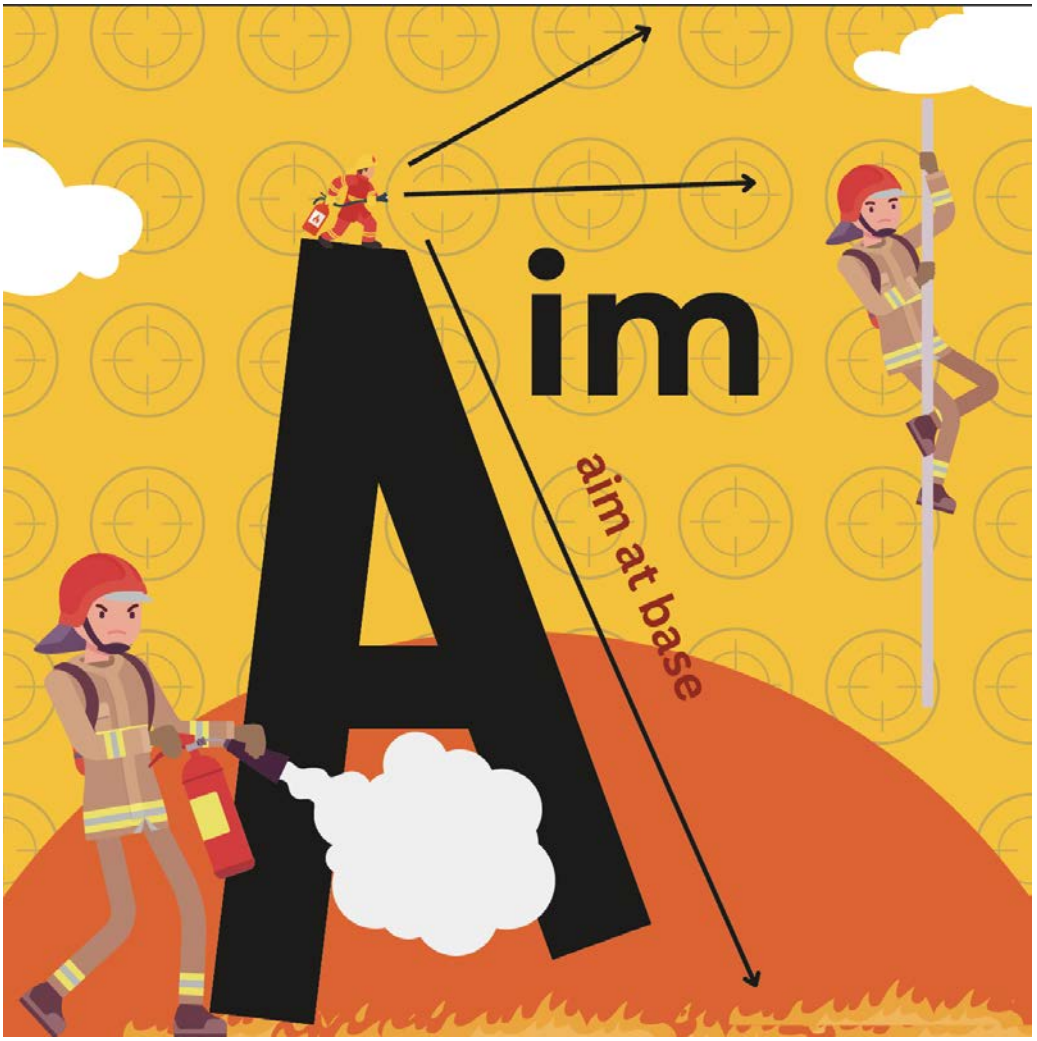
D. Image Tracking for Powder fire extinguisher category

E. Image Tracking for Contact us

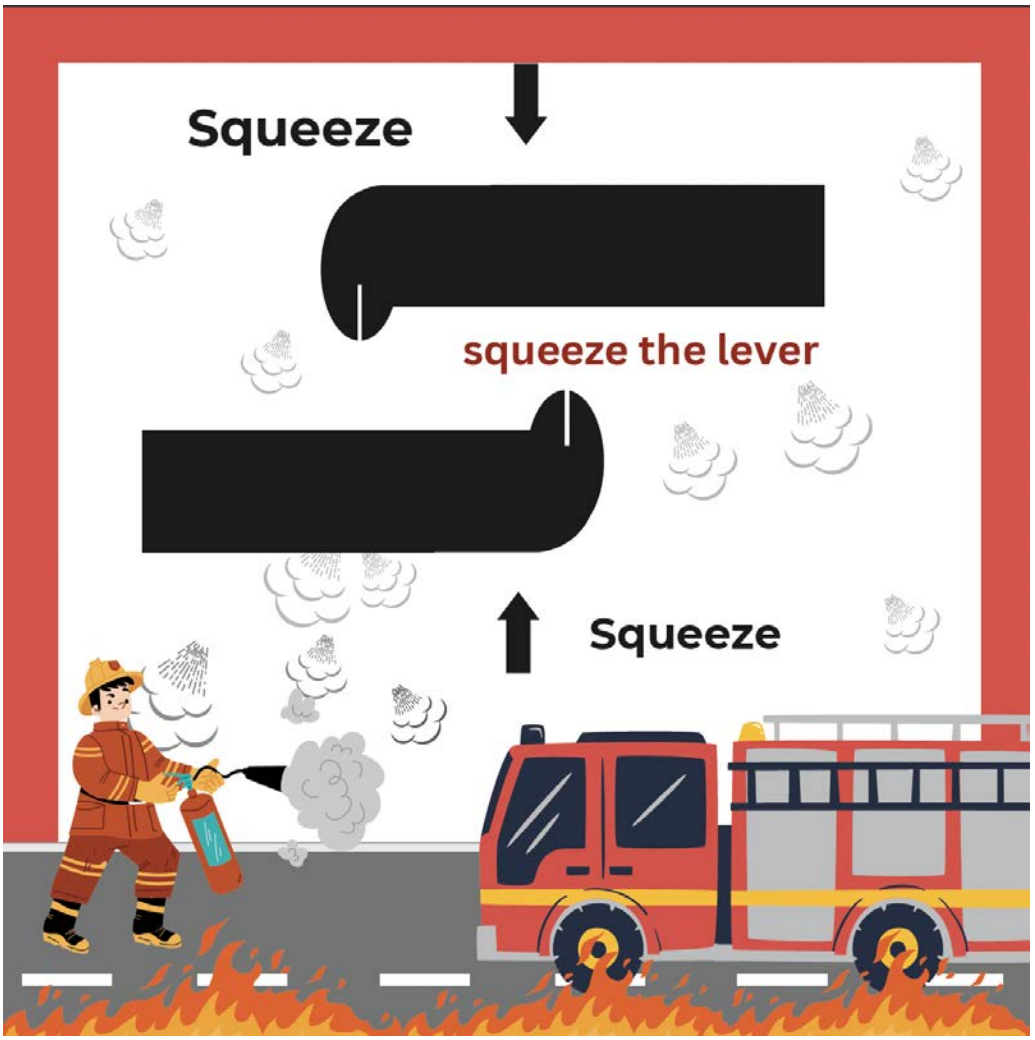
F. Image Tracking for Pull method indicates the steps to put out the fire



G. Image Tracking for Aim method indicates the steps to put out the fire



H. Image Tracking for Squeeze method indicates the steps to put out the fire



I. **Image Tracking for the Sweep method indicates the steps to put out the fire**

In this project, the particle fire is shown in the figure above and it is detected through AR marker technology. You can download it from the Unity store as an asset. Here is the link provided: https://assetstore.unity.com/packages/vfx/particles/particle-pack-127325

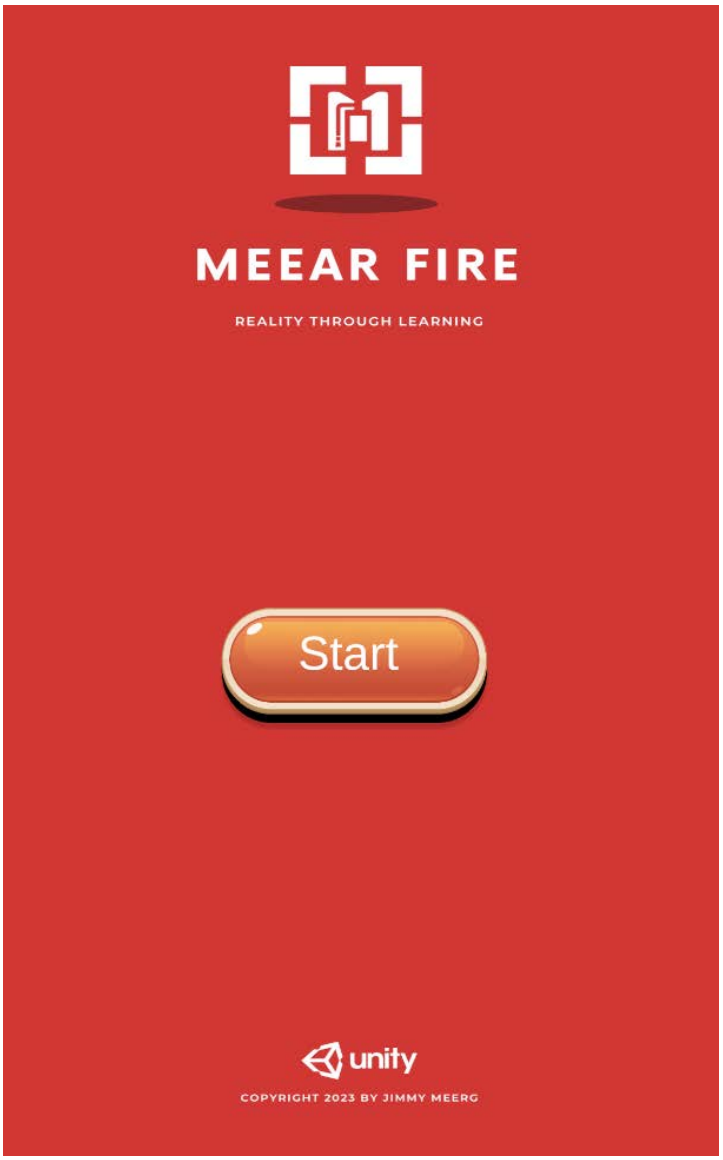
Figure 4.3: 3D object for fire extinguisher

The image displayed above, labelled as Figure 4.3, depicts a 3D model of fire extinguishers. This model has been utilized in various projects, such as defining the categories of fire extinguishers and simulating their use via the PASS method. Here is the link provided:

https://assetstore.unity.com/packages/3d/props/fire-extinguisher-realistic-230711

4.4 INPUT/ OUTPUT DESIGN IMPLEMENTATION

1. Main entrance interface of MeeAR Fire - Augmented Reality Fire Extinguisher Application for Fire Safety Training.



Explanation: This is the main page of MeeAR fire, To proceed to the next scene and experience it with AR, users simply need to click the "Start" button.

2. 4(four) Options: Guide, FireAr, QuisGuisher and Exit.
    - A Guide Module contains 4 sub-modules which are Rotate Fire Extinguisher, AR Information Fire Extinguisher, AR Teacher for Fire Extinguisher, and Contact Us, which 3 of them contain mark-based image tracking and rotation 3D objects.
    - FireAr Module contains markless image tracking with PASS method stimulation.
    - QuizGuishers Module contains 10 quizzes regarding fire extinguishers in Malaysia.
    - Exit button to go to the main entrance page or scene.

Explanation: There are four options provided, with three initial options that lead to a straight path of three more options for users to experience.

3. Guide Module

In the Guide module of the Augmented Reality Fire Extinguisher Application for Fire Safety Training, there are four sub-modules: Rotate Fire Extinguisher, AR Information Fire Extinguisher, AR Teacher for Fire Extinguisher, and Contact Us.

Rotate Fire Extinguisher. In this sub-module, users have the ability to rotate the fire extinguisher along the y-axis for a complete 360-degree view. By clicking on a note, the system displays the price of the fire extinguisher, explicitly focusing on the commonly used ABC powder type in Malaysia. The price list for ABC powder is provided to give users an understanding of the costs involved.

AR Information Fire Extinguisher. This sub-module allows users to experience augmented reality using marker-based. Therefore, Four image targets are implemented for different fire extinguisher categories which are water, CO2, foam, and ABC powder. Users scan the image targets, and when detected, a box appears in the upper left corner indicating the category name of the fire extinguisher. A description box is displayed below, providing information about the fire extinguisher. When the image target is detected, the system displays a 3D model of the fire extinguisher and a box that explains how to use it. Additionally, a sound is played to alert the user.

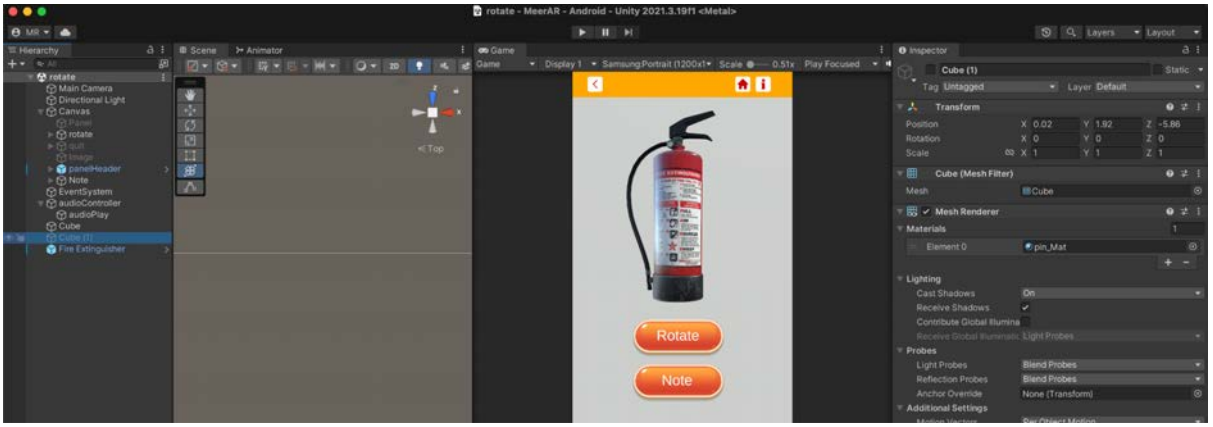
AR Teacher for Fire Extinguisher. This sub-module simulates a classroom-like environment for learning fire extinguishers; it stimulates with water category for fire extinguishers. Basic 3D objects such as cubes and spheres are used. Users can interact with the simulation by shooting at a box, which then transforms into a fire. A sphere representing a balloon is positioned above the fire, symbolizing water. Users can shoot the balloon to put out the fire.

Contact Us. In this sub-module. Users can experience AR marker-based to obtain contact information. By scanning the provided image target, a question mark button appears. Users can click on it to access information on who to contact in case of a fire emergency.

Explanation: Users need to click start learning now to go next scene

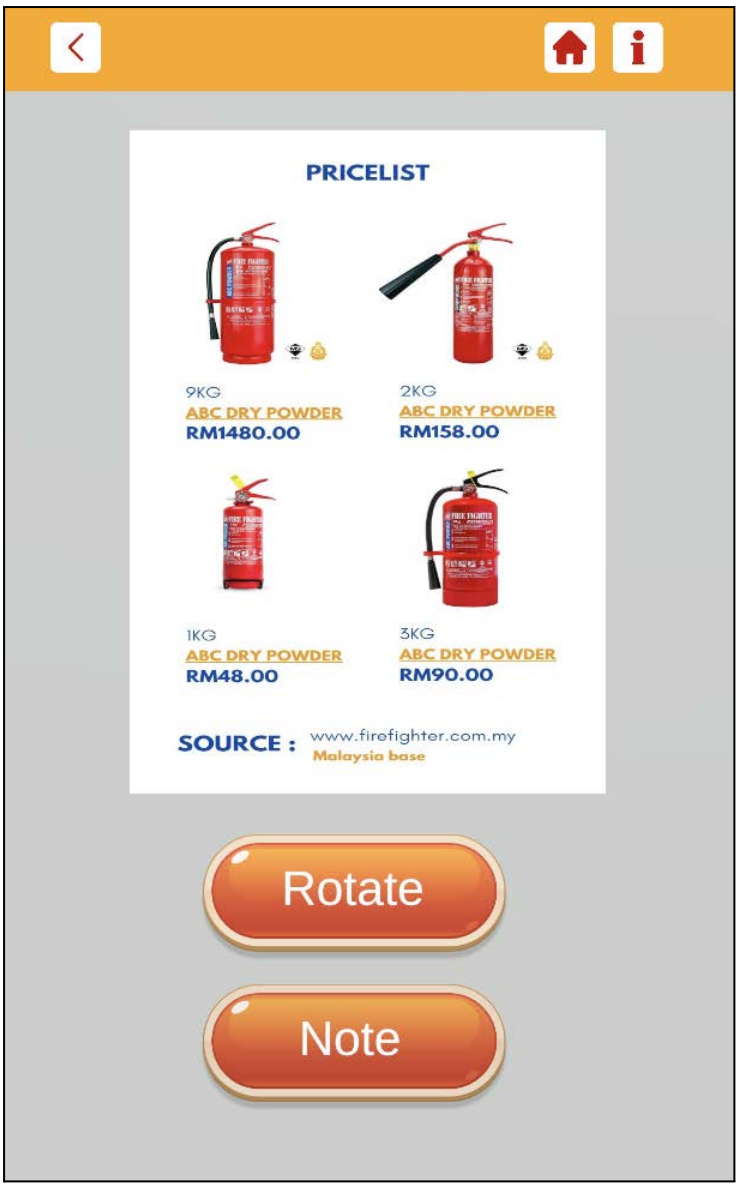
Explanation: There are 4 options, users can experiment with all and gain the knowledge

Input for rotation and note sub module of fire extinguisher



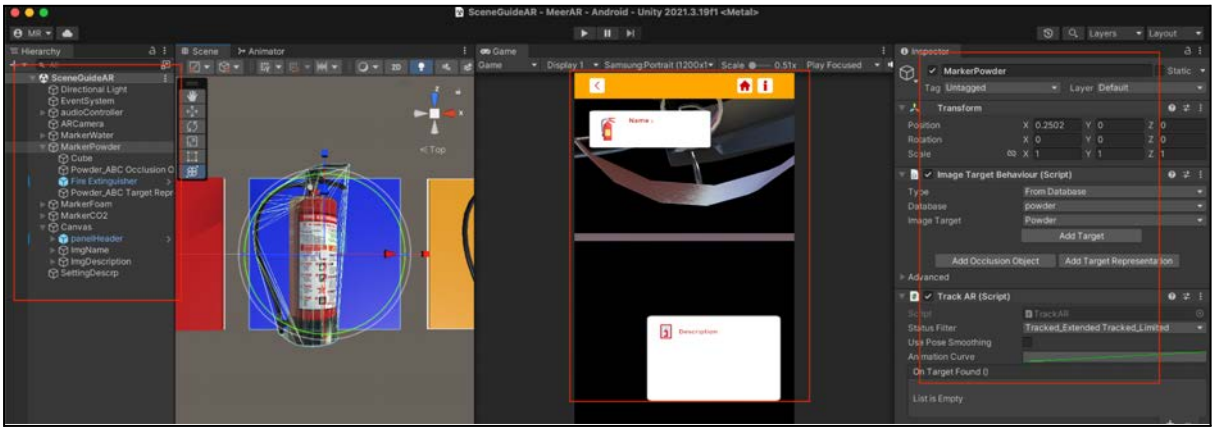
Output:

Explanation: Users have the ability to rotate the fire extinguisher along the y-axis for a complete 360-degree view.

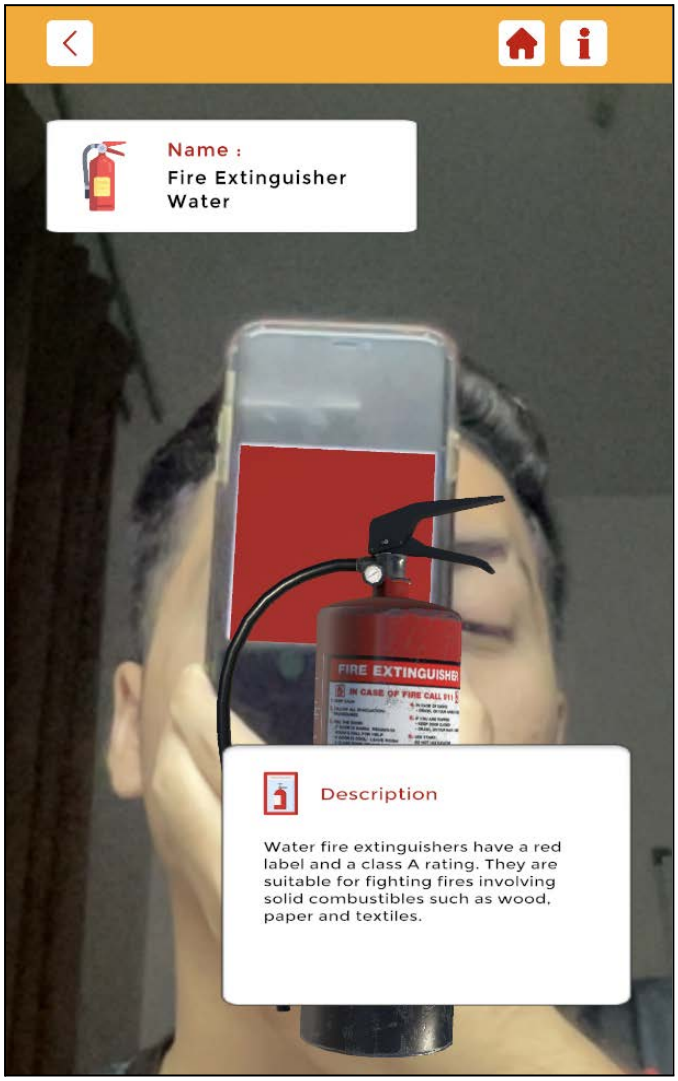


Explanation: By clicking on a note, the system displays the price of the fire extinguisher

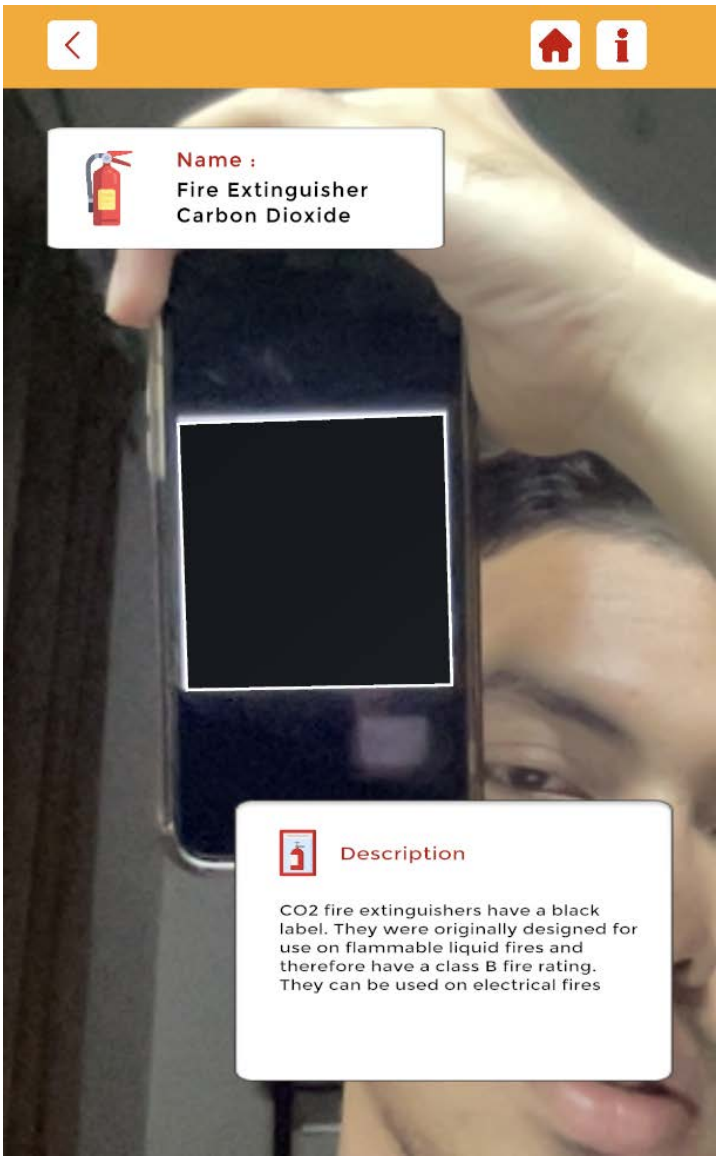
Input for AR information. There are four image target in total that define in this sub-module. Please refer (A. Image Tracking for Water fire extinguisher category) for detaills.



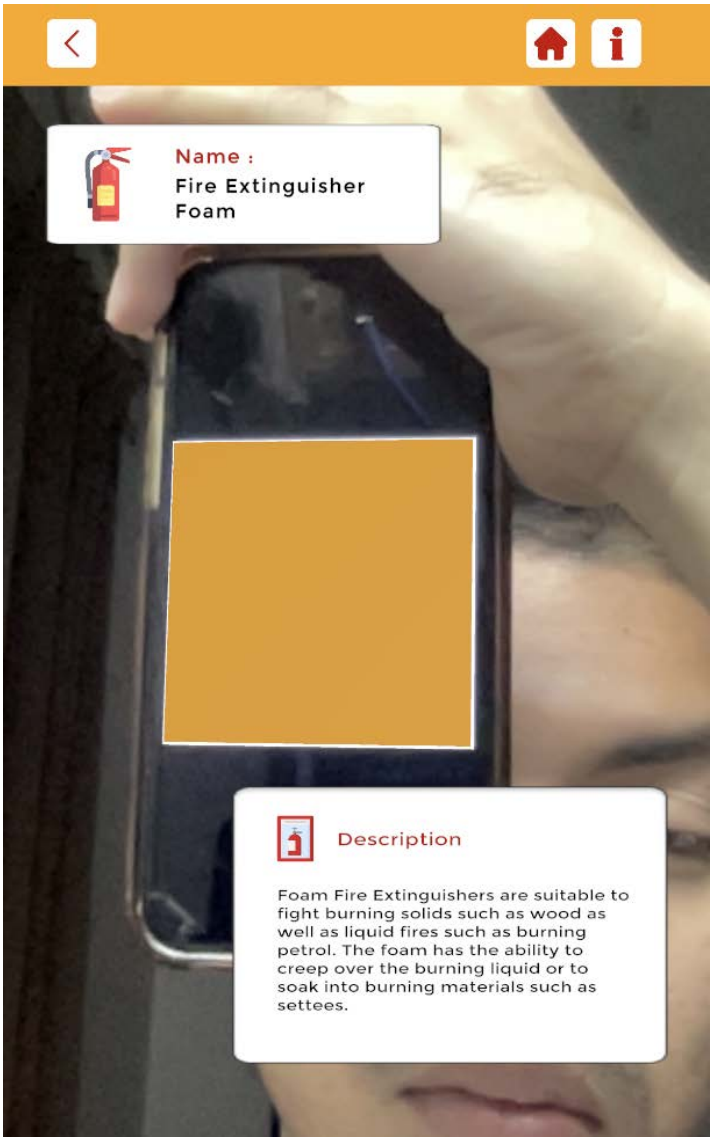
Output:



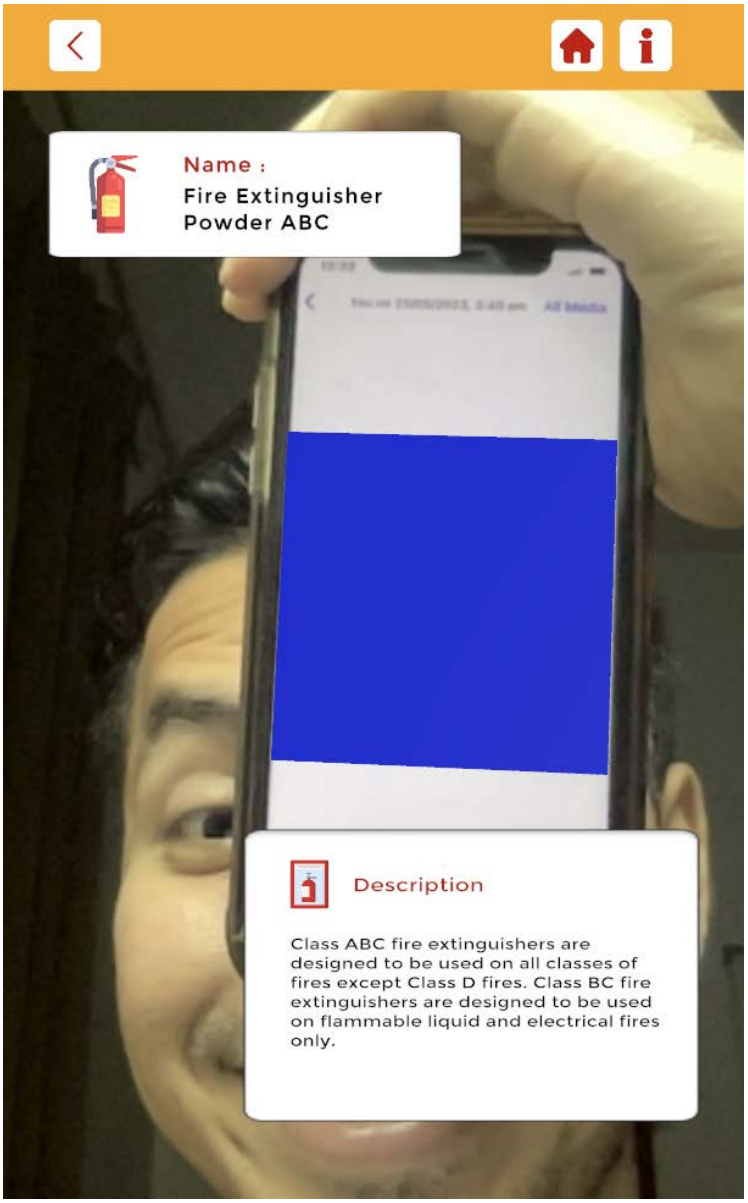
Explanation: By clicking on a note, the system displays the price of the fire extinguisher.



Explanation: Experiment with carbon dioxide category of fire extinguisher

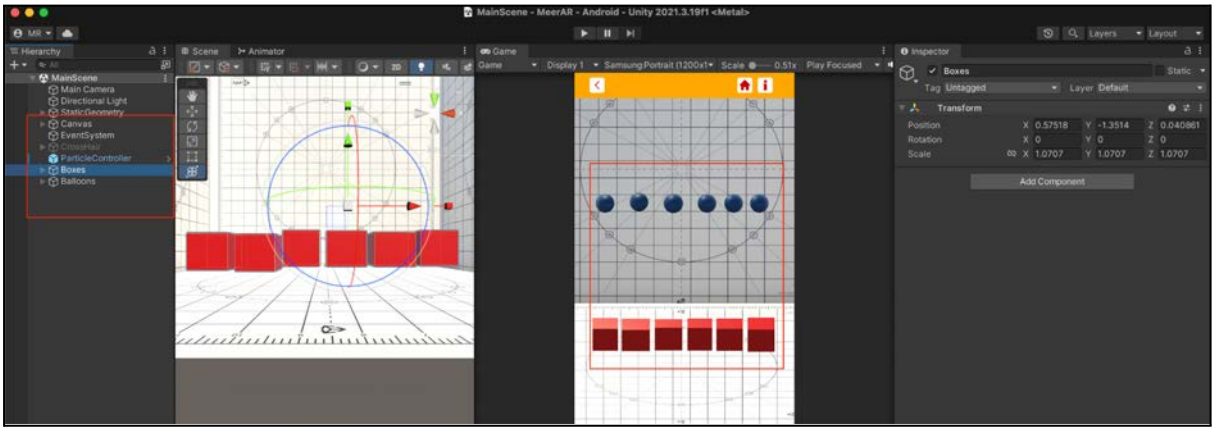


Explanation: Experiment with foam category of fire extinguisher

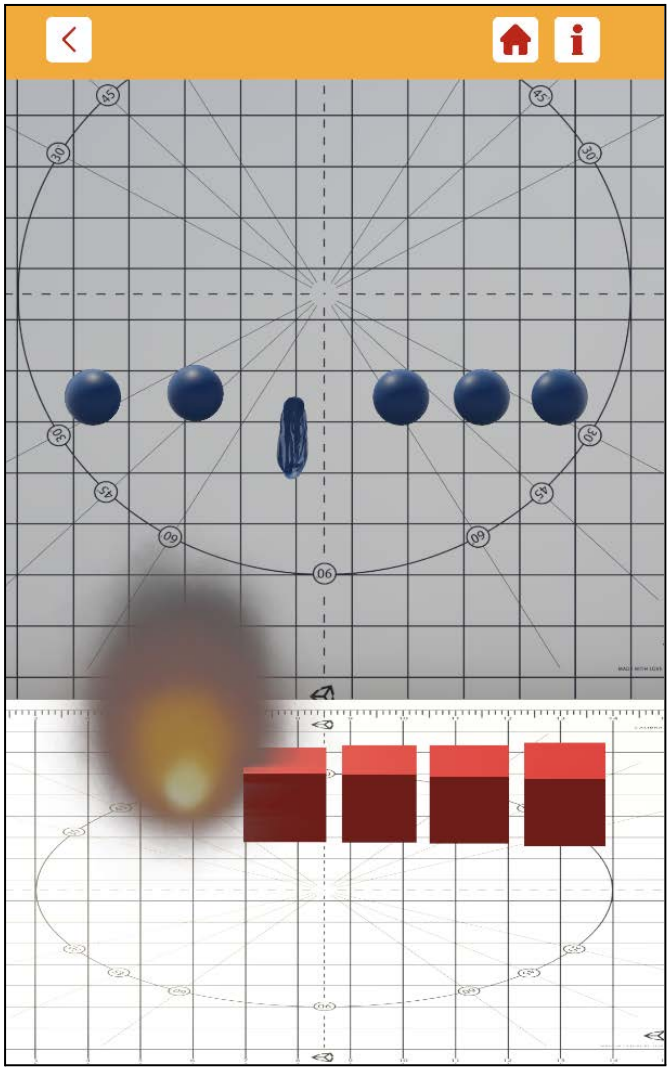


Explanation: Experiment with ABC powder category of fire extinguisher

Input for AR teaching of Fire Extinguisher. Implementing basic box and ballon.

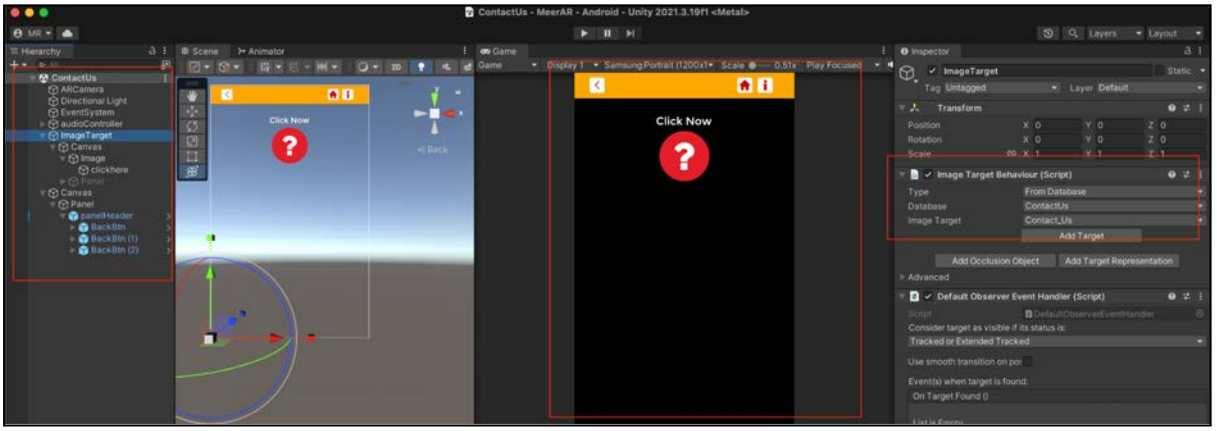


Output:

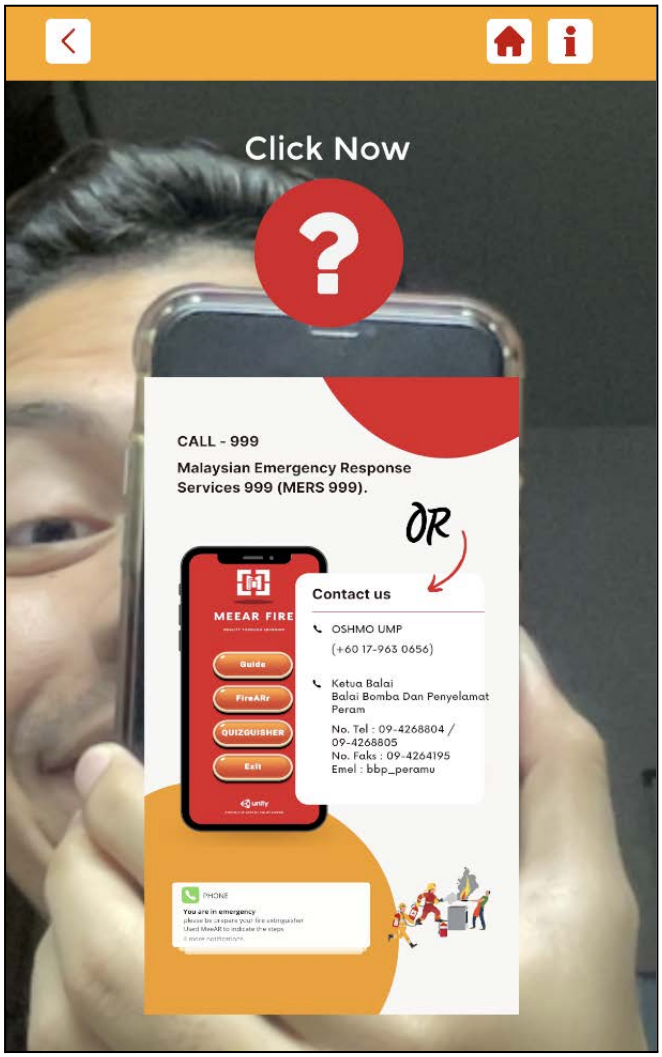


Explanation: Users can shoot the balloon to put out the fire.

Input for contact us. To help users with questions about contacting customer support, we have added a question mark icon. Clicking on it will display a visual that shows how to contact us.



Output:



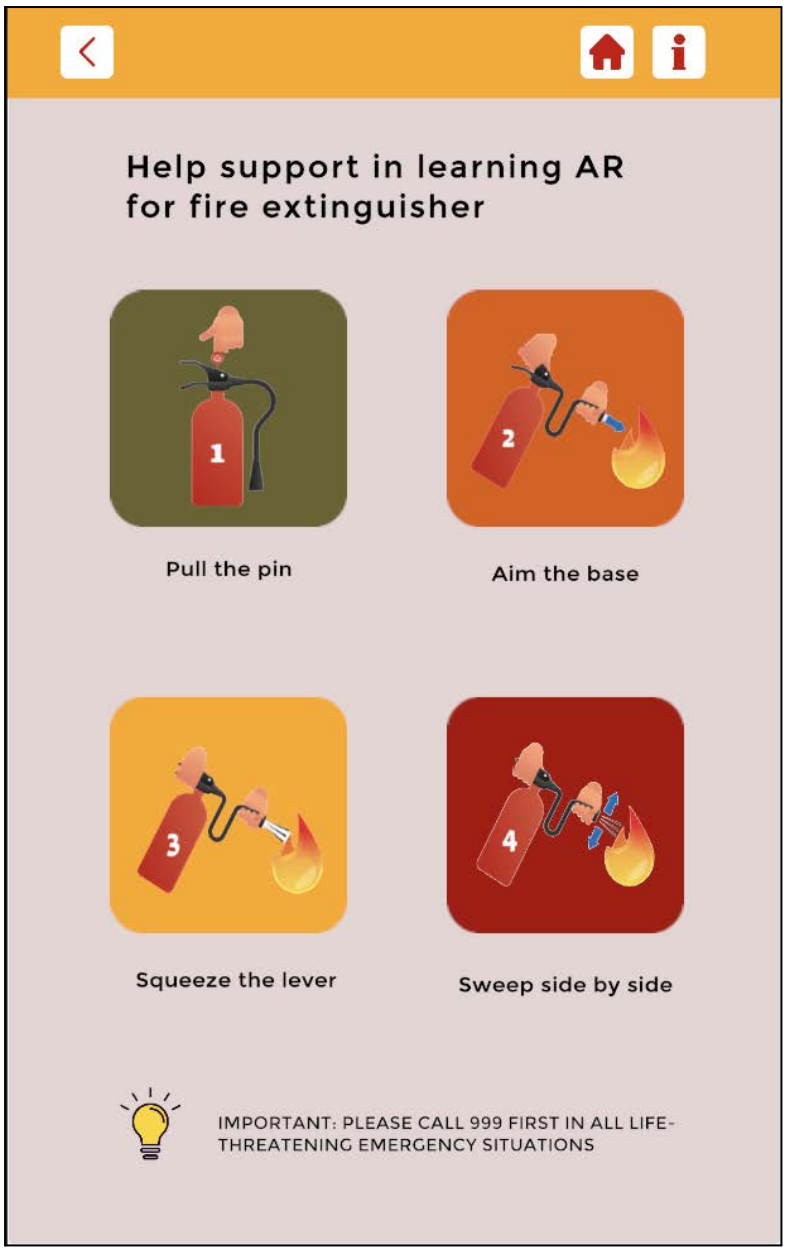
4. FireAR Module

The FireAR module focuses on simulating the process of using a fire extinguisher using the PASS method. It comprises four sub-modules: Pull, Aim, Squeeze, and Sweep.

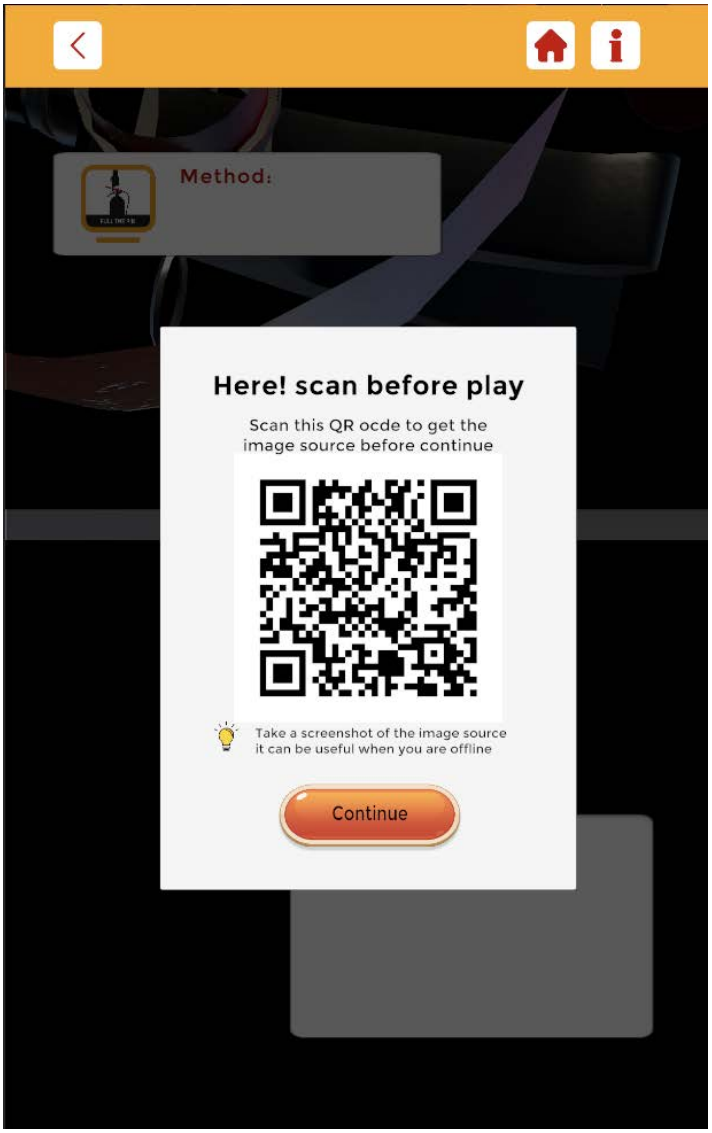
Before entering the AR stimulation, the system prompts users with a QR code, instructing them to scan and locate the image target. Once the user clicks "Continue," a panel appears where users can play an audio briefing about the first step: pulling the pin in fire extinguishers. After that, users can scan the image target and observe the system's response.

In the Pull module, users experience an animation simulation demonstrating how to pull the pin. The user interface displays the method's name at the upper left corner and provides a description below. The Aim, Squeeze, and Sweep modules follow a similar instruction structure, but the animation of the stimulation varies depending on the required action for each step.

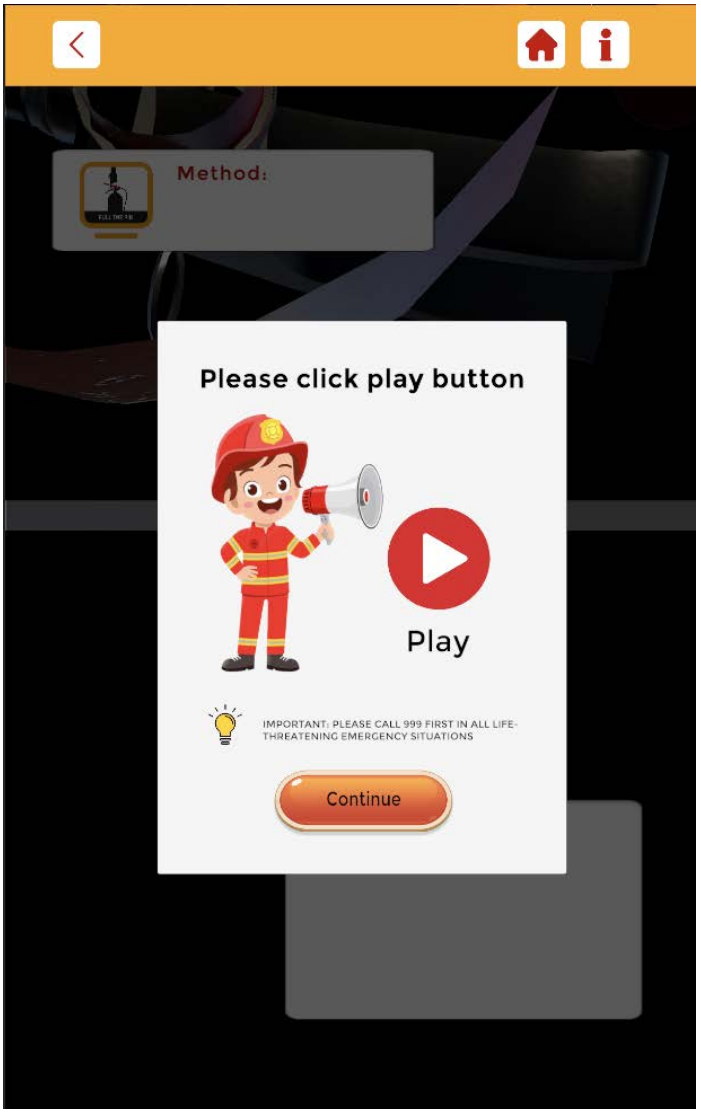
Explanation: Users need to click continue button to go next scene



Explanation: Comprises four sub-modules: Pull, Aim, Squeeze, and Sweepe.Therefore, users can experience AR by choosing either one of the PASS method or the Fire Extinguisher method.

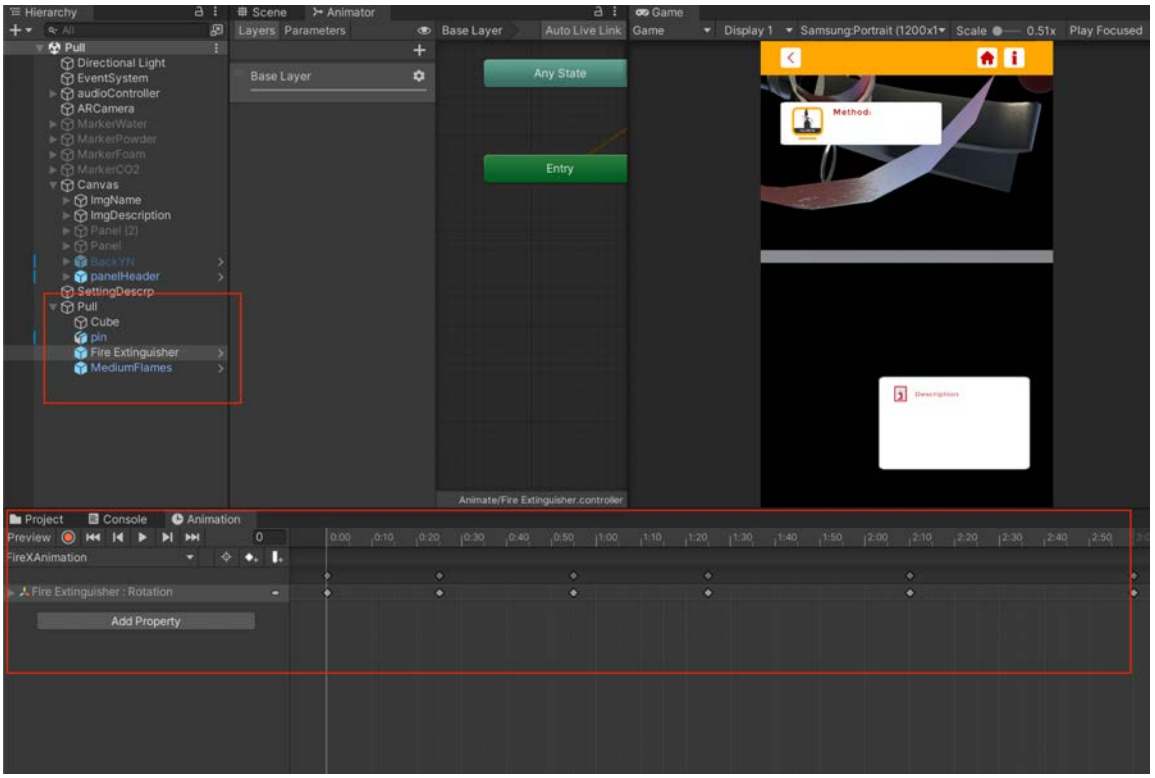


Explanation: The system prompts users with a QR code, instructing them to scan and locate the image target.

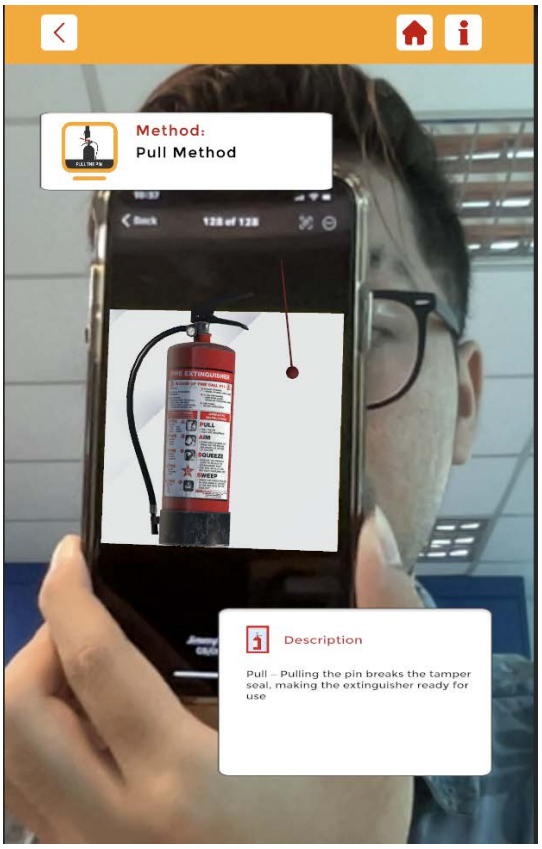


Explanation: Once the user clicks "Continue," a panel appears where users can play an audio briefing about the first step: pulling the pin in fire extinguishers for example.

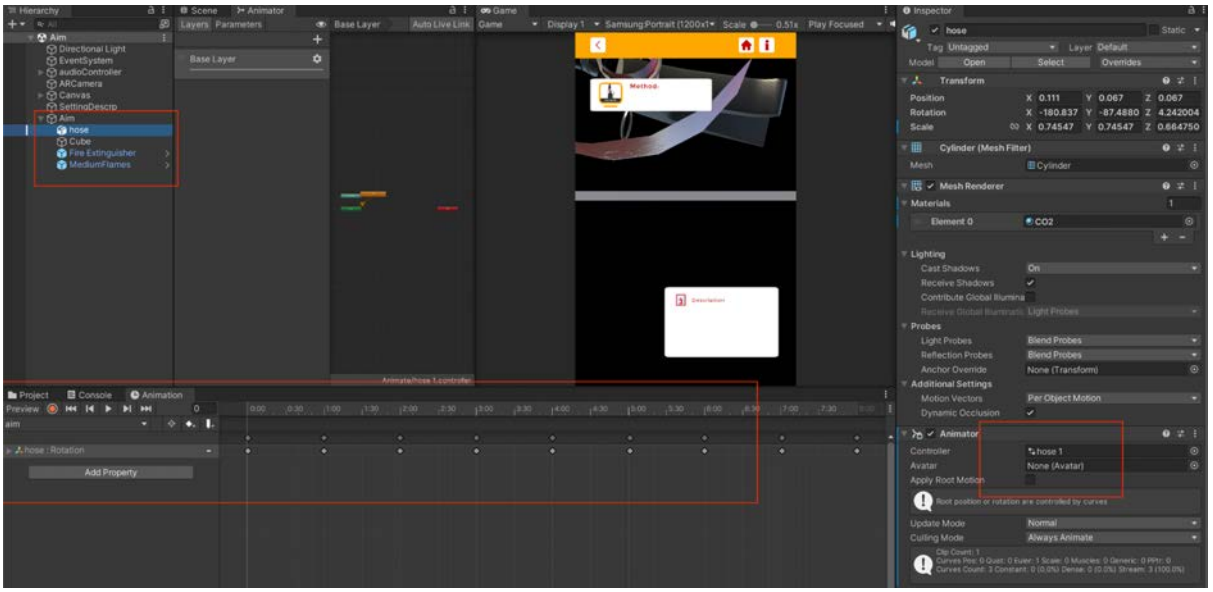
Input for pull method defined in Unity



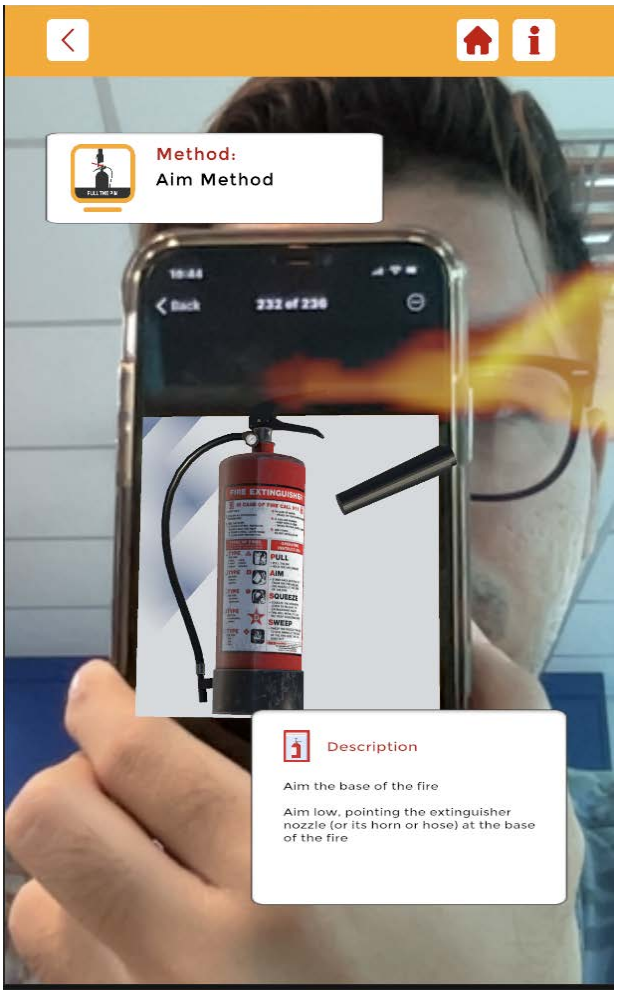
Output:



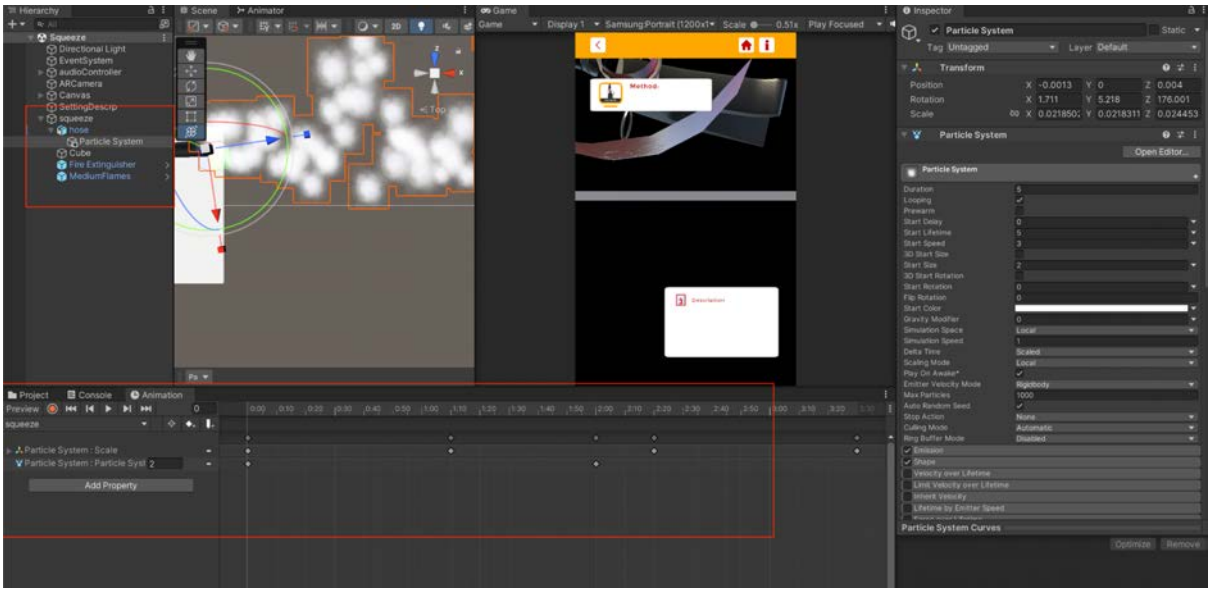
Input for aim method defined in Unity



Output:

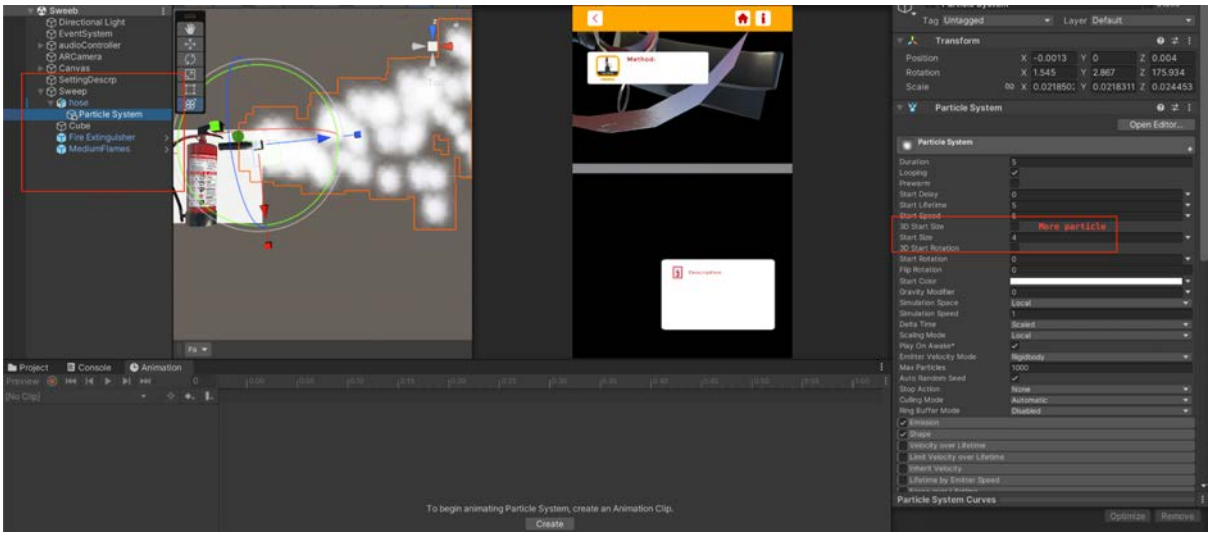


Input for squeeze method defined in Unity

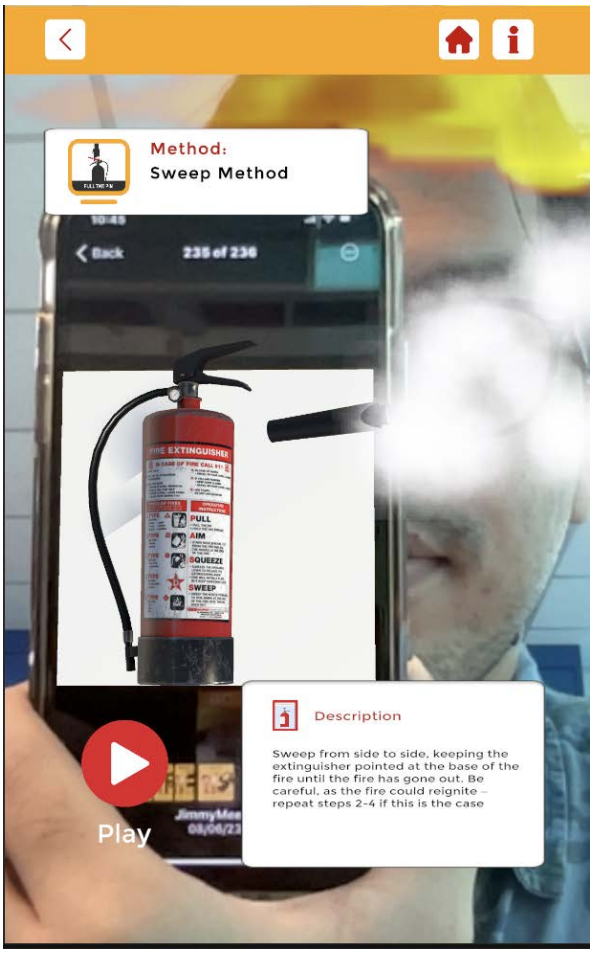


Output:

Input for sweep method defined in Unity. The start size is increased to making particles more.



Output:

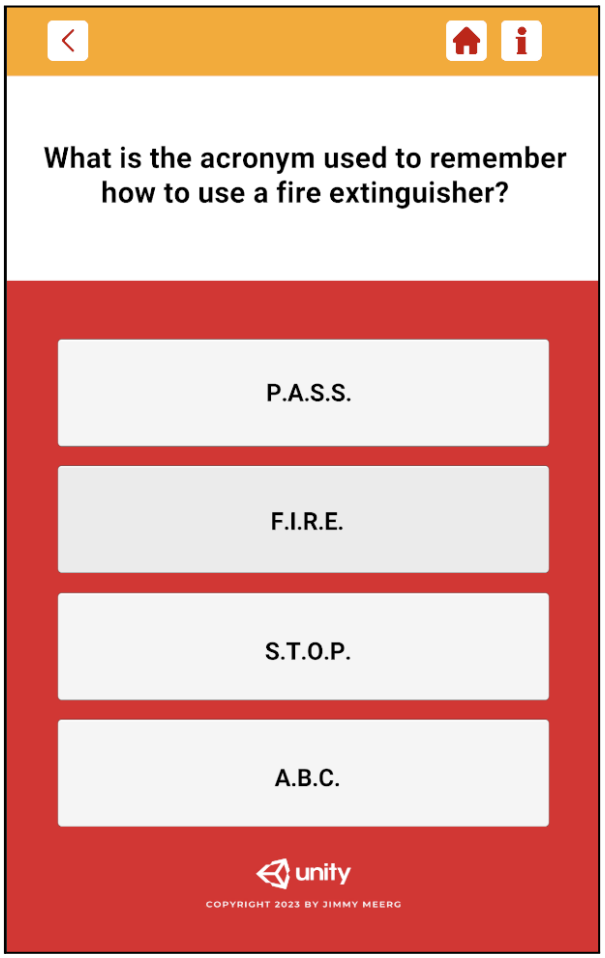


5. Quiz Module

The Quiz module in the Augmented Reality Fire Extinguisher Application presents users with 10 questions related to fire extinguishers. These questions are derived from relevant articles and journals to test users' knowledge on the subject matter.

Once a user selects an answer for a question, the system provides immediate feedback by displaying an indicator box indicating whether the answer is correct or wrong. This feedback helps users understand their level of understanding and reinforces their knowledge.

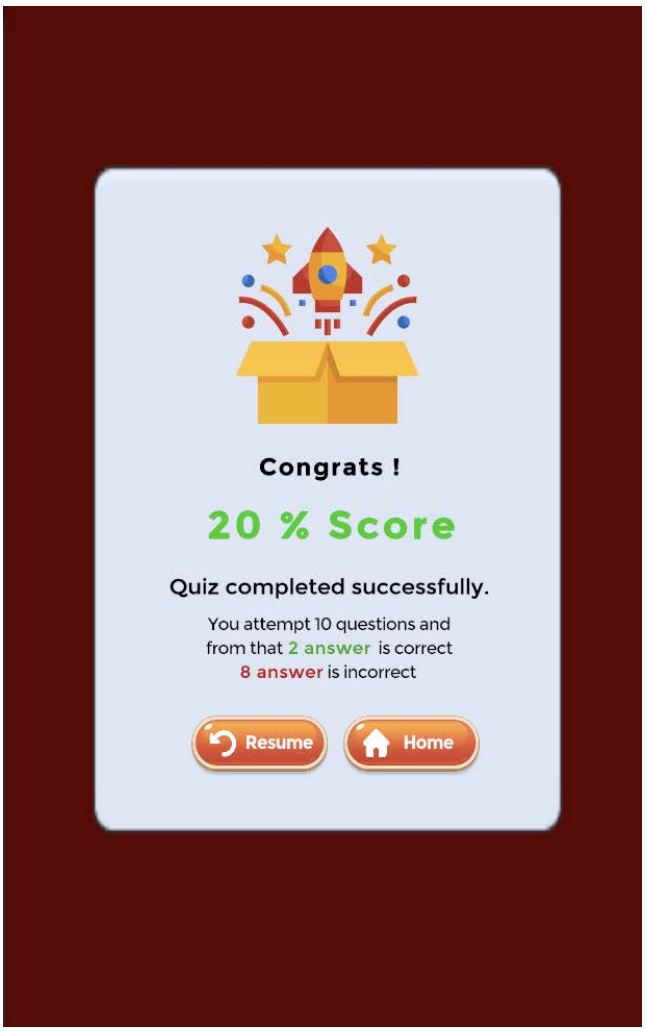
After answering all 10 questions, the system generates a score for the user based on their performance. Users can then choose to either resume the quiz to improve their score or proceed to the next activity within the application. The Quiz module aims to assess users' comprehension of fire extinguisher concepts and provide them with an interactive learning experience.



Explanation: it display the 10 question in total that related to fire extinguishers.

Explanation: Indicate fedback to users by displaying an indicator box indicating for wrong answer

Explanation: Indicate fedback to users by displaying an indicator box indicating for correct answer



Explanation: Generate a score for users performance

4.4 OUTCOME MODULE IMPLEMENTATION

A. Guide Module

The Guide module in the Augmented Reality Fire Extinguisher Application provides users with various interactive experiences and information about fire extinguishers.

In the Rotate Fire Extinguisher sub-module, users can engage with a 3D model of a fire extinguisher and rotate it along the y-axis. Additionally, users are provided with a note containing the price list of ABC powder fire extinguishers, which are commonly used in Malaysia.

The AR Information Fire Extinguisher sub-module allows users to explore different categories of fire extinguishers. By scanning image targets, users can activate augmented reality content that displays a 3D model of the fire extinguisher along with relevant information. A box in the upper left corner indicates the name of the fire extinguisher category, while a description box below provides additional details. The system also includes sound effects to enhance the user experience.

The AR Teacher for Fire Extinguisher sub-module introduces a fun and educational game. It presents a simulation of a classroom setting where users can interact with basic 3D objects such as cubes and spheres. By "shooting" the objects, users can experience the concept of using a water-based fire extinguisher. For example, shooting a balloon-like sphere represents extinguishing a fire with water.

Lastly, the Contact Us sub-module utilises marker-based AR technology. Users can scan an image target to access information on who to contact in case of a fire emergency. Users can review the contact details of relevant authorities or individuals responsible for fire safety by clicking on a button.

The purpose of the Guide module is to offer users useful information and interactive experiences about fire extinguishers by utilizing augmented reality technology.

B. FireAR Module

The FireAR module in the Augmented Reality Fire Extinguisher Application provides users with an interactive and immersive experience to learn and practice the PASS method of using a fire extinguisher.

By following the PASS method (Pull, Aim, Squeeze, Sweep), users can gain a better understanding of the sequential steps required to effectively extinguish a fire in case of an emergency. The module guides users through each step, providing visual animations and instructions.

In the subsequent sub-modules, such as Aim, Squeeze, and Sweep, users can experience the animation simulations associated with each step. The interface displays the name of the method in the upper left corner, and a description of the step is provided below. This allows users to familiarize themselves with the correct techniques and actions required for using a fire extinguisher effectively.

As you progress through the module, you will receive feedback in real-time to ensure that you understand and execute each step accurately. This feedback is designed to enhance your knowledge and skills in handling fire extinguishers, making you better prepared to handle emergency situations in real life.

With the FireAR module, users can practice using a fire extinguisher at their own convenience, wherever and whenever they want. This interactive tool helps users learn and reinforce fire safety knowledge, improving their ability to respond effectively to fire emergencies.

C. Quiz Module

Provided Spreedshet link for a review of the descriptive analysis: https://docs.google.com/spreadsheets/d/1saauTrNWKq7VnjWP9MSLPtHAFLVBjd2AR95h9Euzl6k/edit?usp=sharing

In the problem statement for Chapter 1, it was highlighted that the traditional method of fire extinguisher training lacks adequate real-time feedback for individuals which asking questions to the instructor (Syed, Fathima, & Aromar, 2018) [7]. This issue poses a significant challenge as users often don't have the opportunity to gain comprehensive knowledge about fire extinguishers during training sessions. Consequently, this knowledge gap can hinder the effective use of fire extinguishers in emergency situations.

To address this problem, the descriptive analysis and quiz module were developed within the Augmented Reality Fire Extinguisher Application. This module aims to overcome traditional training methods' limitations by providing users with real-time feedback and enhancing their understanding of fire extinguishers.

By utilising the gathered data from the 23 respondents who completed the questionnaire, the module aims to improve the training experience by presenting interactive quizzes and engaging content. The selected 10 questions, based on the difficulty and discrimination indices, play a crucial role in delivering targeted and effective training to users. Through this approach, users can acquire a comprehensive knowledge of fire extinguishers and enhance their ability to use them appropriately during emergencies.

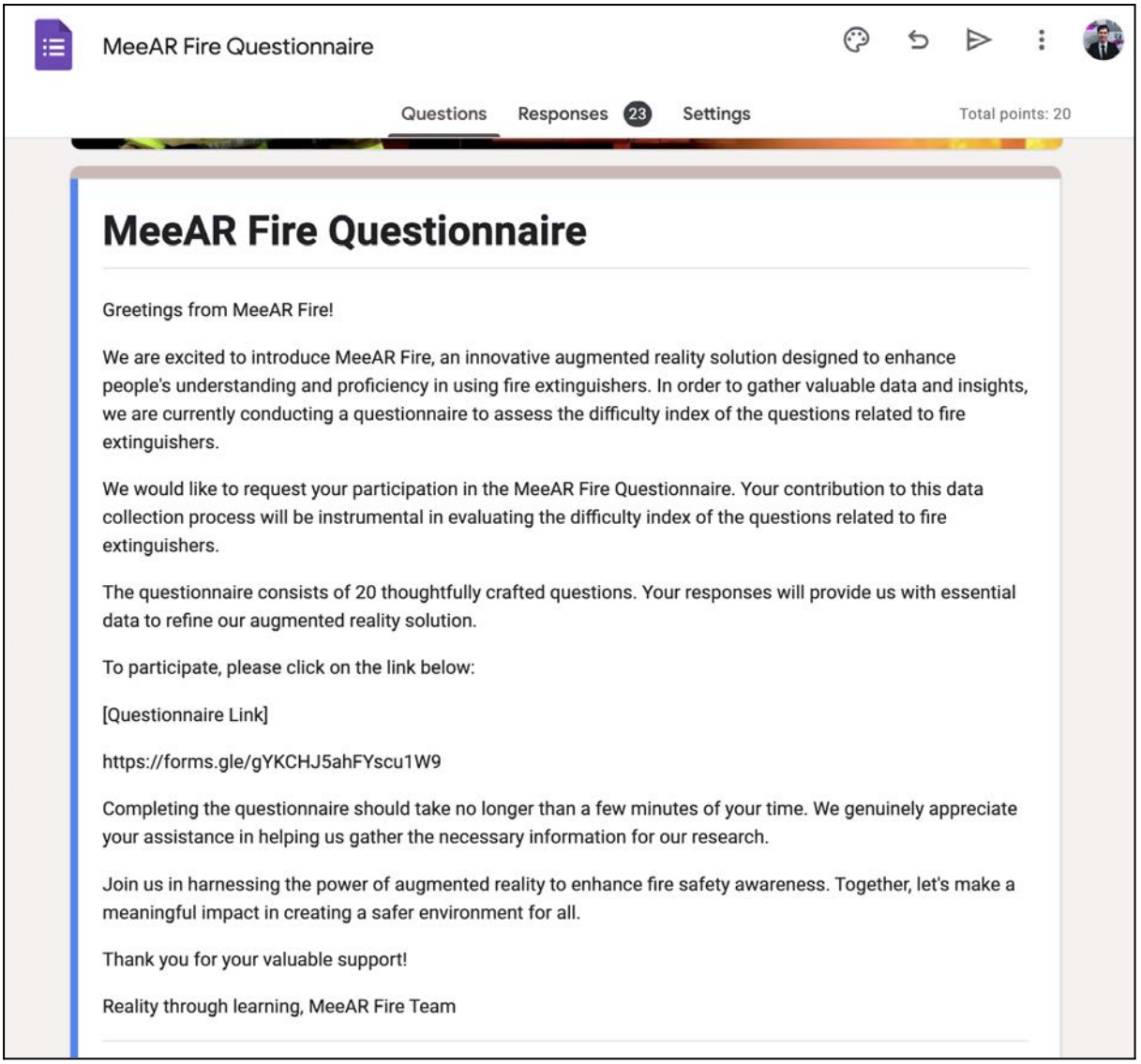
By incorporating the descriptive analysis and quiz module into the Augmented Reality Fire Extinguisher Application, it is expected that the issue of inadequate real-time feedback and limited knowledge about fire extinguishers during training sessions can be effectively resolved. Below are the 20 questions, answer option and answer that are questionnaires.

Table 4.1: List of 20 questions, answer options and answer of the questions

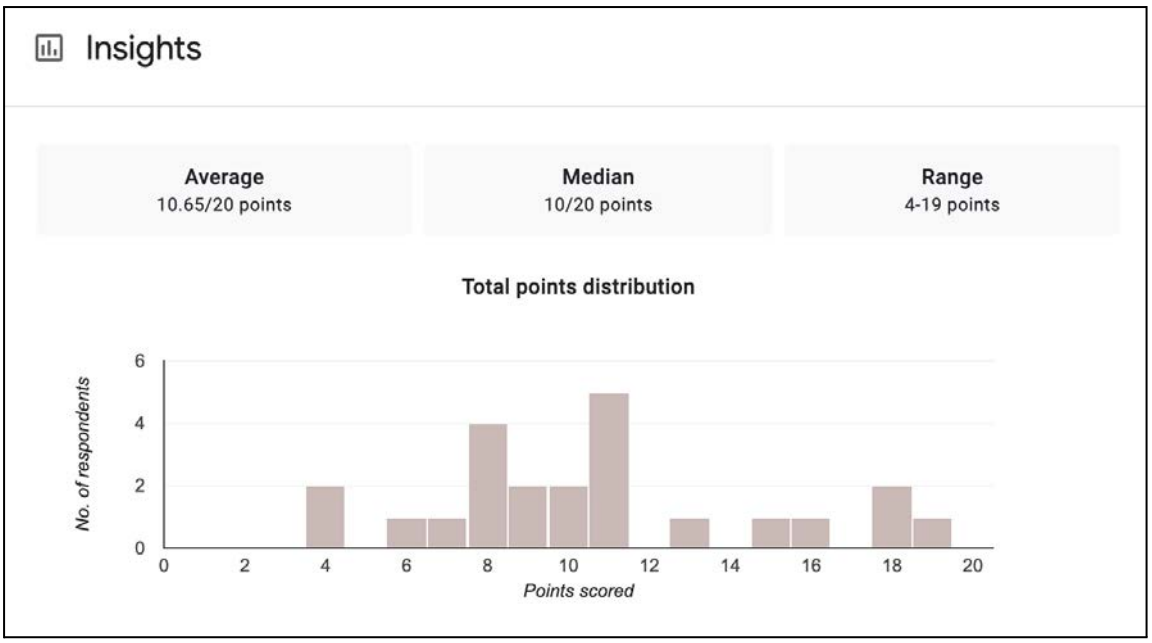
No	Questions	Answer Option	Ans
1.	What is the acronym used to remember how to use a fire extinguisher?	A. P.A.S.S. B. F.I.R.E. C. S.T.O.P. D. A.B.C.	A
2.	What type of fire is a Class A fire extinguisher suitable for?	A. Fires involving flammable liquids B. Fires involving electrical equipment C. Fires involving ordinary combustibles like wood or paper D. Fires involving metals	C
3.	Which type of fire extinguisher is suitable for use on flammable liquid fires?	A. Class A B. Class B C. Class C D. Class D	B
4.	What is the maximum distance you should be from a fire when using a fire extinguisher in Malaysia?	A. 2-3 meters B. 4-6 meters C. 7-9 meters D. 10-12 meters	A
5.	When using a fire extinguisher, what is the correct method to aim at the fire?	A. Aim at the base of the flames B. Aim at the top of the flames C. Aim at the surrounding area of the fire D. Aim directly at the smoke	A
6.	How often should fire extinguishers be inspected in Malaysia?	A. Every 6 months B. Every year C. Every 2 years D. Every 5 years	B
7.	What is the first thing you should do if you discover a fire?	A. Try to extinguish the fire with a fire extinguisher B. Call the fire department C. Evacuate the building immediately D. Turn off all electrical equipment in the area	C

8.	What does the "A" in the ABC classification of fire extinguishers stand for?	A. Ashes B. Acids C. Alkalines D. Ordinary combustibles	D
9.	What type of fire extinguisher is specifically designed for electrical fires?	A. Water extinguisher B. Foam extinguisher C. Carbon dioxide (CO2) extinguisher D. Dry powder extinguisher	C
10.	Which fire extinguisher type should be used for fires involving cooking oils or fats?	A. Water extinguisher B. Foam extinguisher C. Carbon dioxide (CO2) extinguisher D. Wet chemical extinguisher	D
11.	What is the purpose of the safety pin found on a fire extinguisher?	A. To prevent accidental discharge B. To ensure proper pressurisation C. To indicate the extinguisher's readiness D. To secure the extinguisher during transportation	A
12.	Which fire extinguisher type should NOT be used for electrical fires?	A. Water extinguisher B. Foam extinguisher C. Carbon dioxide (CO2) extinguisher D. Dry powder extinguisher	A
13.	What is the proper procedure for checking if a fire extinguisher is fully charged?	A. Weighing the extinguisher B. Observing the pressure gauge C. Shaking the extinguisher D. Checking the expiration date	B
14.	Which fire extinguisher type is most effective for fires involving solid combustible materials like wood or paper?	A. Water extinguisher B. Foam extinguisher C. Carbon dioxide (CO2) extinguisher D. Dry powder extinguisher	A

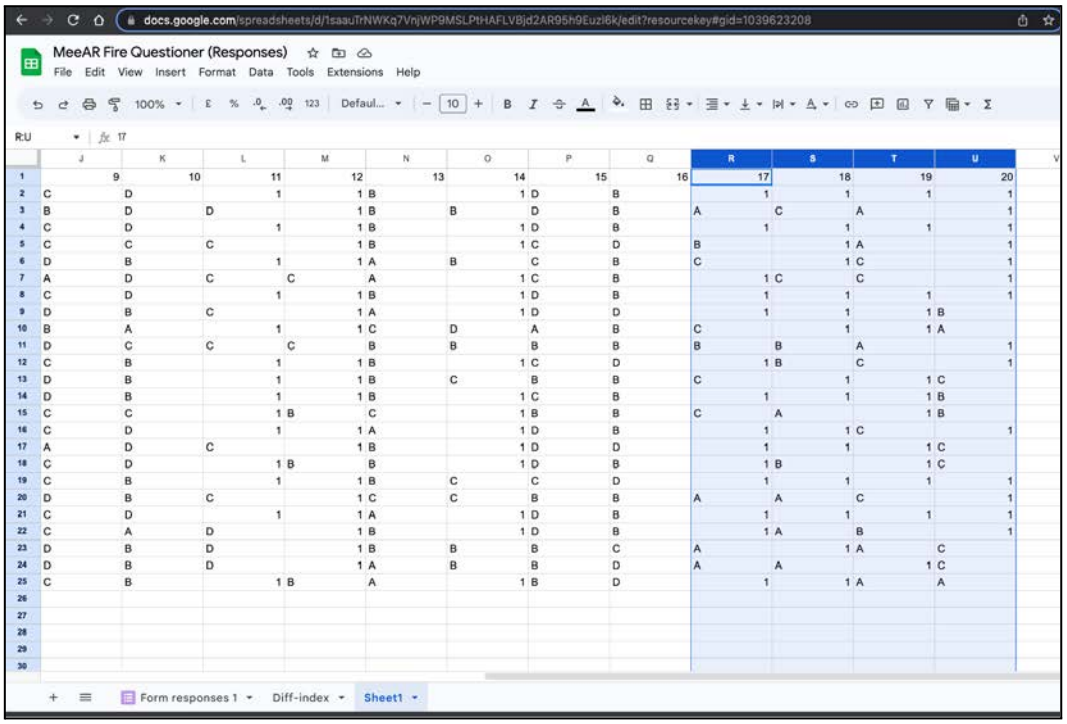
15.	Which fire extinguisher type should be used for fires involving cooking appliances, such as stoves or deep fryers?	A. Water extinguisher B. Foam extinguisher C. Carbon dioxide (CO2) extinguisher D. Wet chemical extinguisher	D
16.	What should be done if a fire extinguisher fails to control a fire?	A. Use another extinguisher to supplement the effort B. Evacuate the premises immediately C. Attempt to control the fire using other means D. Wait for professional firefighters to arrive	B
17.	When storing a fire extinguisher at home, what factors should be considered to ensure its functionality in case of an emergency?	A. Temperature and humidity conditions B. Proximity to potential fire hazards C. Visibility and accessibility D. All of the above	D
18.	What are the common signs of a fire extinguisher that may need maintenance or replacement?	A. Damaged or missing parts B. Expired pressure gauge C. Corrosion or rust on the canister D. All of the above	D
18.	What are the potential causes of decreased functionality in a fire extinguisher over time?	A. Exposure to extreme temperatures B. Improper storage conditions C. Lack of regular maintenance D. All of the above	D
20.	What is the extinguishing agent used in ABC-type fire extinguishers?	A. Water B. Carbon dioxide (CO2) C. Foam D. Dry chemical powder	D



Explanation: The questionnaire was conducted via Google Form, in total there are 20 points for each question indicated by 20 questions in all.



Explanation: The insights show the average, median and range points that gain by respondents.



Explanation: Convert the answers to either Correct (code 1) or Incorrect (code 0), as illustrated above by using replace all, question by question. For example, Identify the key answer for Question 1. For example, let's say the key answer for Question 1 is "A". Utilize

the "Find and Replace" function in a spreadsheet. In the "Find" field, enter the key answer, which is "A" in this case. In the "Replace" field, enter the corresponding replacement value, which is "1" in this case. Click on the "Replace All" button to initiate the replacement process.

	Difficulty Index
Average Difficulty Index	53.26
	Discrimination Index
Average Discrimination Index	0.09
	***PQ**
Average PQ Index	4.61

Variance	17.69
***PKR20**	1.15
****SD**	4.21
*****SEM**	1.61

*Kuder and Richardson Formula 20 Reliability Index
*Standard deviation
****Standard Error of Measurement
***Sum of all PQ

Explanation: Then calculate the Average Discrimination, difficulty and PQ Index
p of each question (p = probability of correct answer)
q of each question (q = probability of the wrong answer)

Standard error of measurement (SEM) is related to test reliability

This shows how much the measurement errors vary when estimating someone's true quiz scores from their observed scores.

Standard Error Measurement *= Standard deviation (s^2) * SQRT (1 – Reliability(PKR20))*
*Standard Error of Measurement = 17.69 * SQRT (1 – 0.78) = 1.61*

So it is 1.61

Difficulty Index (D)	Discrimination Index (R)
43.48	0.00
43.48	0.17
56.52	0.00
26.09	-0.17
86.96	-0.33
47.83	-0.17
47.83	0.00
47.83	0.00
47.83	0.00
34.78	0.50
56.52	0.17
78.26	0.00
56.52	0.33
60.87	0.17
39.13	0.17
65.22	0.33
56.52	0.00
60.87	0.17
52.17	0.00
56.52	0.50

Difficulty Index(D)	D = Respondent with correct answer / Total number of student X 100
Discrimination Index (R)	R = (H – L) of 27% of Total / 6

**27% out of 23 respondent = 6.21 (round up)*
= 6 respondent by calc

H = number of correct answers from top 27% of respondent
L = number of corrects answers from bottom 27% of respondent

Explanation: Then calculate the Discrimination and difficulty Index. The goal is to determine the total index of the question compared to the student's answer.

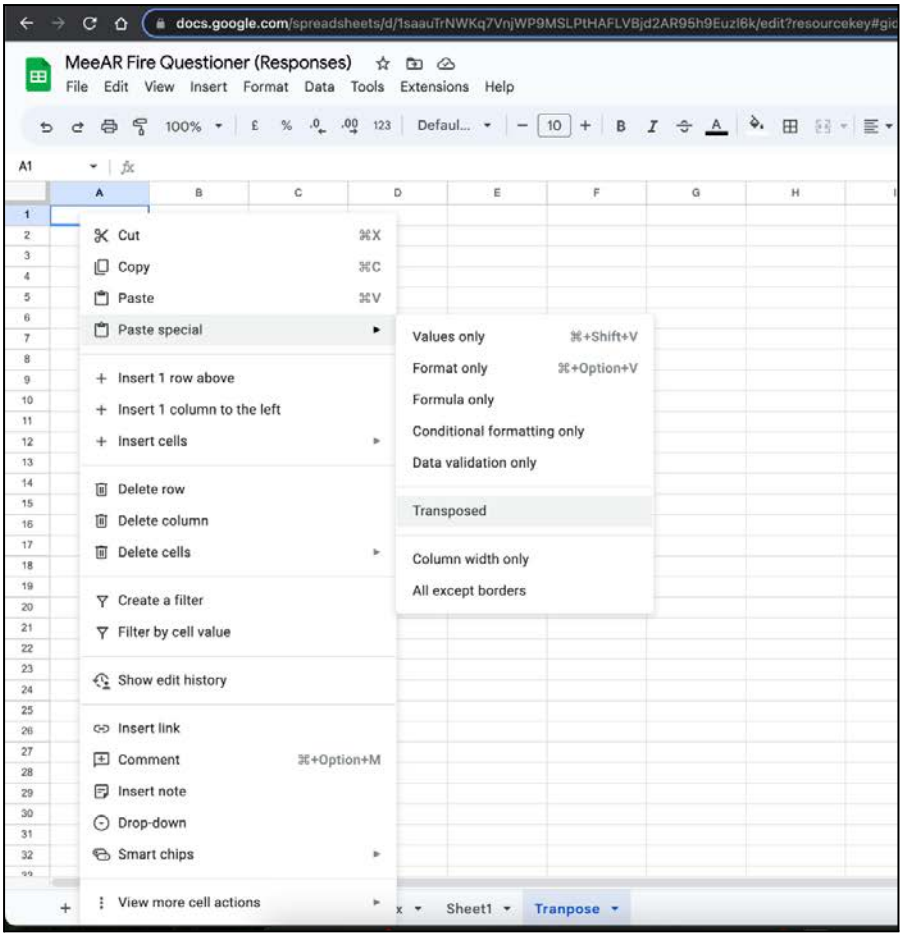
Table 4.2: Interpretation of the Difficulty Index (D)

Range	Difficulty Index (D)
20 & below	Very difficult
21-40	Difficult
41-60	Average
61-80	Easy
81 & above	Very easy

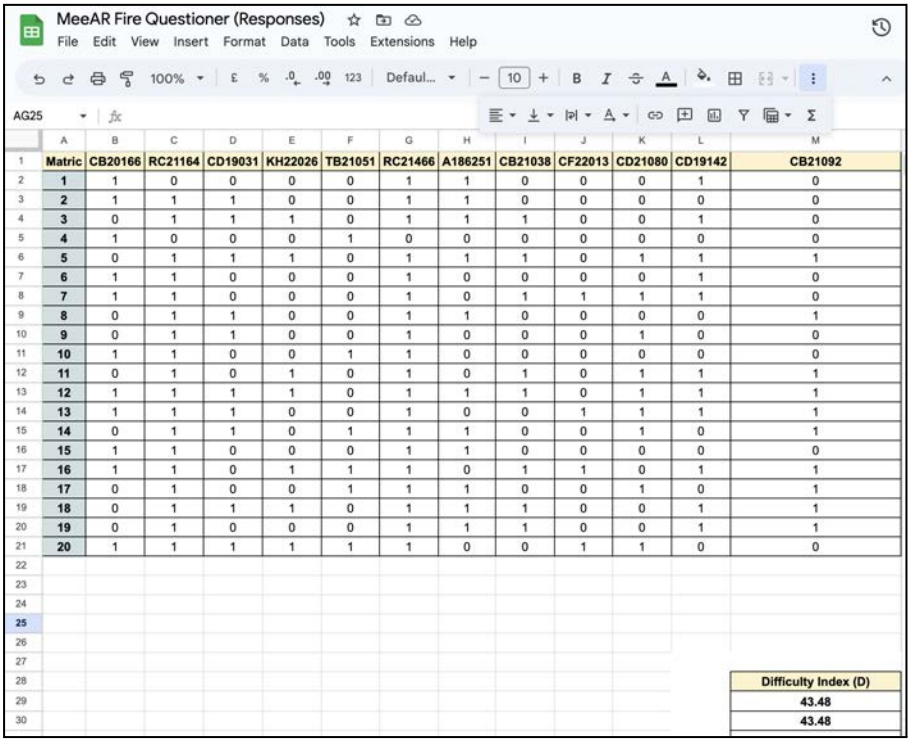
Table 4.3: Interpretation of the Discrimination Index (R)

Range	Discrimination Index (R)
.40 & below .30 - .39 .20 - .29 .09 - .19	Very Good Item Good Item Fair Item Poor Item

Table above shows Discrimination Index, In this example, there are 23 respondents. To determine the number of correct answers, calculate 27% of 23 respondents, which is approximately 6 respondents. We will then take the number of correct answers from the top 6 respondents (H) and subtract the number of correct answers from the bottom 6 respondents (L). Finally, we will divide the result by 6.



Explanation: Transposing the Difficulty and Discrimination Index for Analysis -



Matric	CB20166	RC21164	CD19031	KH22026	TB21051	RC21466	A186251	CB21038	CF22013	CD21080	CD19142	CB21092
1	1	0	0	0	0	1	1	0	0	0	1	0
2	1	1	1	0	0	1	1	0	0	0	0	0
3	0	1	1	1	0	1	1	1	0	0	1	0
4	1	0	0	0	1	0	0	0	0	0	0	0
5	0	1	1	1	0	1	1	1	0	1	1	1
6	1	1	0	0	0	1	0	0	0	0	1	0
7	1	1	0	0	0	1	0	1	1	1	1	0
8	0	1	1	0	0	1	1	0	0	0	0	1
9	0	1	1	0	0	1	0	0	0	1	0	0
10	1	1	0	0	1	1	0	0	0	0	0	0
11	0	1	0	1	0	1	0	1	0	1	1	1
12	1	1	1	1	0	1	1	1	0	1	1	1
13	1	1	1	0	0	1	0	0	1	1	1	1
14	0	1	1	0	1	1	1	0	0	1	0	1
15	1	1	0	0	0	1	1	0	0	0	0	0
16	1	1	0	1	1	1	0	1	1	0	1	1
17	0	1	0	0	1	1	1	0	0	1	0	1
18	0	1	1	1	0	1	1	1	0	0	1	1
19	0	1	0	0	0	1	1	1	0	0	1	1
20	1	1	1	1	1	1	0	0	1	1	0	0

Difficulty Index (D)
43.48
43.48

Explanation: The result of transposing the Difficulty and Discrimination Index for Analysis

Difficulty Indexes				
		Bin	*Frequency*	*Cumulative %*
Valid	Difficult	47.83	9	45.00%
	Average	60.87	8	85.00%
	Easy	86.95	2	95.00%
	Very Easy	More	1	100.00%
		Total	20	100.00%

Discrimination Indexes				
		Bin	*Frequency*	*Cumulative %*
Valid	Indiscriminal	0.09	11	55.00%
	Poor	0.33	5	80.00%
	Good	0.5	4	100.00%
	Very Good	More	0	100.00%
		Total	20	100.00%

Explanation: This is the total measurement , to make it easier to analyse the calculated Difficulty and Discrimination Index for all 20 questions, let's transpose the current table. Above is the result for categorising the data and creating a frequency table.

Difficulty Index (D)	
Mean	53.26
Standard Error	3.10
Median	54.35
Mode	56.52
Standard Deviation	13.88
Sample Variance	192.77
Kurtosis	1.19
Skewness	0.54
Range	60.87
Minimum	26.09
Maximum	86.96
Sum	1,065.22
Count	20.00
Largest(1)	86.96
Smallest(1)	26.09
Confidence Level(95%)	6.50

Discrimination Index (R)	
Mean	0.09
Standard Error	0.05
Median	0.00
Mode	0.00
Standard Deviation	0.21
Sample Variance	0.05
Kurtosis	0.15
Skewness	0.30
Range	0.83
Minimum	-0.33
Maximum	0.50
Sum	1.83
Count	20.00
Largest(1)	0.50
Smallest(1)	-0.33
Confidence Level(95%)	0.10

Explanation: Performing a descriptive data analysis internally for further review can be done by transposing the data.

$KR_{20} = \frac{K}{K-1}\left[1 - \frac{\sum pq}{\sigma^2 X}\right]$	$s^2 = \frac{\sum (x - \bar{x})^2}{n - 1}$
source:(renzpaz, 2010)	source:(Xie, 2019) S^2 is sample variance

Therefore rho PKR20 = (1-4.61(average PQ Index)/17.69(sample variance) * 20(total question)/19(total number of question - 1) = 0.78

Refer to table 1 above for total measurement.

Since rho = 0.78, therefore the questions are highly reliable. According to

Conclusion,

I have categorised them into three groups: low, moderate, and high difficulty.

Low	10. Which fire extinguisher type should be used for fires involving cooking oils or fats? 13. What is the proper procedure for checking if a fire extinguisher is fully charged? 16. What should be done if a fire extinguisher fails to control a fire? 20. What is the extinguishing agent used in ABC-type fire extinguishers?
Moderate	2. What type of fire is a Class A fire extinguisher suitable for? 11. What is the purpose of the safety pin found on a fire extinguisher? 15. Which fire extinguisher type should be used for fires involving cooking appliances, such as stoves or deep fryers? 18. What are the common signs of a fire extinguisher that may need maintenance or replacement?
High	1. What is the acronym used to remember how to use a fire extinguisher? 7. What is the first thing you should do if you discover a fire?

The questions labelled as "low" difficulty are Question 20, Question 13, Question 16, and Question 10. These questions have relatively lower difficulty indices, indicating they are easier than the other questions. However, their discrimination indices suggest that there is some level of discrimination between the lower-scoring and higher-scoring respondents. For instance, in Question 13, the difficulty index is 56.52, implying moderate difficulty. The discrimination index of 0.33 indicates that the lower-scoring respondents performed relatively well in answering the question than the higher-scoring respondents. This suggests that the knowledge required to answer these questions is more accessible to the lower-scoring respondents.

The questions classified as "moderate" difficulty are Question 18, Question 15, Question 2, and Question 11. These questions fall within a moderate range of difficulty. For example, Question 18 has a difficulty index of 60.87, indicating that it is moderately challenging. The discrimination index of 0.17 suggests that there is some discrimination between the lower-scoring and higher-scoring respondents in terms of their understanding of fire extinguishers. This indicates that both groups could benefit from acquiring additional knowledge to improve their performance.

Lastly, the questions categorised as "high" difficulty are Question 1 and Question 7. These questions have higher difficulty indices, making them the most challenging among the 20 questions. Question 1, for instance, has a difficulty index of 43.48, indicating a high difficulty level. However, the discrimination index of 0 suggests that there is no significant difference in performance between the lower-scoring and higher-scoring respondents. This implies that both groups struggled equally with this question, suggesting that it requires a substantial amount of knowledge and understanding of fire extinguishers to answer correctly.

In conclusion, I have analyzed a total of 10 over 20 questions, dividing them into three categories: low, moderate, and high difficulty levels. This is to ensure that users who will take and answer Augmented Reality Fire Extinguisher Application for Fire Safety Training quiz module will find the questions familiar, but not too easy or difficult to guess. This approach encourages user enjoyment while facilitating knowledge acquisition and retention.

CHAPTER 5

CONCLUSION

5.1 OVERVIEW

This chapter is mainly about the overall conclusion of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE overviews the project's conclusions, objectives and problem achievement, contribution drawbacks, future enhancements and project limitations. The project has successfully developed an interactive training experience using augmented reality technology, allowing users to practice fire extinguisher operation through virtual scenarios. However, certain limitations and challenges were encountered during development, such as technical constraints against the stimulation structure due to limited knowledge. To improve the application, future enhancements may include expanding content and scenarios, incorporating real-time feedback and assessment, and integrating social and collaborative elements for group training. These improvements aim to create a more comprehensive and user-friendly experience, enhancing fire safety education and preparedness.

5.2 OBJECTIVE ACHIEVEMENT

5.2.1 Comprehensive understanding of existing augmented reality fire extinguisher applications. For example, it is important to have a thorough understanding of the benefits and limitations of augmented reality fire extinguisher applications, informative feedback and entertainment users with quiz modules that can gain knowledge about fire extinguishers.

5.2.2 Development of an augmented reality fire extinguisher application. The application incorporates interactive modules, which are AR rotation and note that display the pricelist and the user can rotate the 3D object, AR information by 4 categories (water, carbon dioxide, foam and ABC powder, implement AR teacher to entertain users by shooting the

boxes and ballons that indicating to put out the fire, and even apply AR for contact us so that user can experiment AR technology even small things. Therefore, provide users with stimulation animation for the PASS method of fire extinguishers and lastly provide the quiz for gain knowledge. Additionally , it will engage all the features to provide users with an enhanced learning experience.

5.2.3 Evaluation of functionality and usability of the MeeAR Fire application. User feedback was collected, testing was conducted, and comprehensive assessments were performed

5.3 PROBLEM ACHIEVEMENT

5.3.1 For problem costly and time-consuming fire safety drills. (refer to Syed, Fathima, & Aromar, 2018) [7].

The project has been achieved by cost-effective and time-efficient fire safety training. The MeeAR FIRE application utilises augmented reality technology to provide a cost-effective alternative to traditional fire safety drills. This allows users to undergo comprehensive fire safety training conveniently and efficiently without the need for extensive time commitments and expensive on-site training.

5.3.2 For problem workplace risks with traditional training methods. (refer to (Gourley, 2020) [8].

The project has been achieved by enhanced workplace safety through innovative training methods using AR and Vuforia technology. MeeAR FIRE has introduced augmented reality-based training modules to address workplace risks associated with traditional training methods. This application simulates hazardous situations and provides interactive experiences to help users develop practical skills and knowledge to handle fire emergencies effectively, whether on-site or off-site.

5.3.3 For problem Inadequate real-time safety information (X. Li, W. Yi, Hung-Lin C., Xiangyu W., Albert P.C. C., 2018) [9]

The project has been achieved by real-time safety information and feedback. At MeeAR FIRE, we offer interactive modules that provide real-time safety information to our users, which are users who can define the categories for fire extinguishers, entertain with AR teachers, and contact us with information and stimulation animation for the PASS method. During training sessions, our users receive instant feedback and guidance to ensure they acquire accurate and up-to-date knowledge about fire extinguishers and safety procedures.

5.3.4 For problems, limited opportunity to learn about fire extinguishers during training. (refer to Syed, Fathima, & Aromar, 2018) [7]

The project has been achieved by comprehensive learning opportunities, which are AR for categories of information that display descriptions of fire extinguishers and even the quiz that entertains users to gain knowledge. MeeAR FIRE fills the gap of limited learning opportunities by providing users with a comprehensive platform for understanding and practising fire extinguisher usage. The application offers a range of modules, such as the Guide, FireAR, and Quiz modules, which enable users to gain more experience, improve their skills, and test their knowledge of properly using fire extinguishers.

5.4 DRAWBACK AND FUTURE ENHANCEMENT

This project development greatly benefits from RAD methodology because RAD helps to reduce developing time because of prototyping, reduces manual coding using code generator and reuse code, provides more flexibility when redesigning depends on the developer, offers the opportunity for fewer prototype defects and can obtain reliable user feedback.

During the development of the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE, certain limits should be noted for future reference and identified. Problems can occur before, during or after the process has been completed. There

are future suggestions and improvements due to these limitations of MeeAR Fire for further improvement in the next future versions.

To improve MeeAR FIRE's Augmented Reality Fire Extinguisher Application for Fire Safety Training, my suggestion is to integrate ARCore for Android and ARKit for macOS. This would allow access to advanced AR features that can interact with reality more powerfully. For instance, in the current module, only animation stimulation is used to cover the PASS method for fire extinguishers. By incorporating ARCore and ARKit, MeeAR FIRE can integrate an advanced development ecosystem of AR, making communication with humans more efficient and effective.

After conducting a survey and analyzing my own progress, I believe that to achieve further improvement, integrating 3D models with AR technology would be beneficial. This can be achieved by using our own generation process with 3D tools such as Blender or Maya.

5.5 PROJECT CONSTRAINTS/LIMITATIONS

Throughout this project, certain limitations or constraints were identified while developing the Augmented Reality Fire Extinguisher Application for Fire Safety Training. The limits and constraints identified during project development are described in this subtopic below:

i. Skill constraints

Limited skills are available to the developer itself, who is a beginner in discovering the features of Unity for personality. In addition, the learning and teaching plan from the teaching structure is not exposed. They need to search the system itself and apply augmented reality using the Unity platform. When they are discovering and learning the platform or language, it could take time to understand it fully before using it.

ii. Limitation

a) Augmented Reality Fire Extinguisher Applications for Fire Safety Training cannot precisely track weather using markless or marked-based.

b) Augmented Reality Fire Extinguisher Application for Fire Safety Training will be able to user encounter with limited user experiences due to designing user interface in Unity less impact.
c) The system has limited options for users to discover the product outcome.

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APPENDICES A

ALPHA TESTING TECHNIQUE

As mentioned in *Chapter 3* (refer to cutover - RAD as methodology), the testing technique that has been approached are Alpha and Beta testing techniques.

I utilized the Alpha testing method to assess the usability and functionality of the Augmented Reality Fire Extinguisher Application, specifically for Fire Safety Training purposes - MeeAR FIRE. To optimize the application, I enlisted the help of two friends from the Multimedia and Graphics department, who were experienced in developing AR plus they used various content in the Unity engine.

FUNCTIONALITY ACCEPTANCE TESTING (FAT) **AUGMENTED REALITY FIRE EXTINGUISHER APPLICATION FOR FIRE SAFETY TRAINING - MeeAR FIRE**							
Name: MUHAMMAD FAHMI BIN MOHD RAZI Phone Number: +601137486447 Email: jimmybusinessmail@gmail.com						**Date: 11 June 2023**	
No.	**ID**	**Acceptance Criteria**	**Expectation Result**	**Actual Result**	**Pass / Fail**	**Inspection Type**	**Remarks**
1.	ARFX001	Able to click all the button	All the button functions well	Indicate correct location	Pass	E	
2.	ARFX002	Rotate the fire extinguisher using the y-axis navigation	Successfully rotate the fire extinguisher using the y-axis navigation when clicking rotate button	Rotation against the y-axis	Pass	E	
3.	ARFX003	Displayed price information when clicking the note button	Successfully show price information when clicking the note button	Appear note when click	Pass	E	
4.	ARFX004	Able to scan the image targets for different fire extinguisher categories	Successfully scan the image targets for different fire extinguisher categories	Scan and display	Pass	E	
5.	ARFX005	Display category names and descriptions of the fire extinguishers	Successfully show category names and descriptions of the fire extinguishers	Display the correct category name and description	Pass	E	

6.	ARFX006	Correct 3D model for position and appearance	Successfully have a 3D model for position and appearance	Position of the 3D model in correctly	Pass	A	
7.	ARFX007	Interact with the simulation by shooting at the fire and balloon objects	Successfully Interact with the simulation by shooting at the fire and balloon objects	The boxes turn up the fire, and the ballon pulls over the water	Pass	E	3D model does not stick well at image target
8.	ARFX008	Able to scan the image target and access the contact information	Successfully scan the image target and access the contact information	Scan and display	Pass	E	
9.	ARFX09	Button question mark in contact can click well	Successfully click the button	Click and display information	Pass	E	
10.	ARFX010	Display the QR code and scan to get the image target in correctly	Successfully shows QR code and scan to get the image target in correctly	Appear the QR and scan.	Pass	E	
11.	ARFX011	Audio briefing for all methods functions well	Successfully display the audio briefing for all methods functions well	Appear sounds with the correct audio	Pass	E	
12.	ARFX012	Display animation simulations for pulling the pin, aiming, squeezing, and sweeping clearly	Successfully show animation simulations for pulling the pin, aiming, squeezing, and sweeping clearly	Animation and display information	Pass	E	
13.	ARFX013	Display quiz questions accurately	Successfully show quiz questions accurately	Appear the questions and answer options	Pass	E	
14.	ARFX014	Can click the options in quiz module	Successfully click the options in quiz module	Correct location	Pass	E	
15.	ARFX015	Display feedback for indicating wrong or correct answer	Successfully show feedback for indicating wrong or correct answer	Correct feedback	Pass	E	
16.	ARFX016	Display scoring system correctly		Correct score	Pass	E	

For inspection type: E-excellent, A-average, P-poor

FUNCTIONALITY ACCEPTANCE TESTING (FAT)
AUGMENTED REALITY FIRE EXTINGUISHER APPLICATION FOR FIRE SAFETY TRAINING - MeeAR FIRE

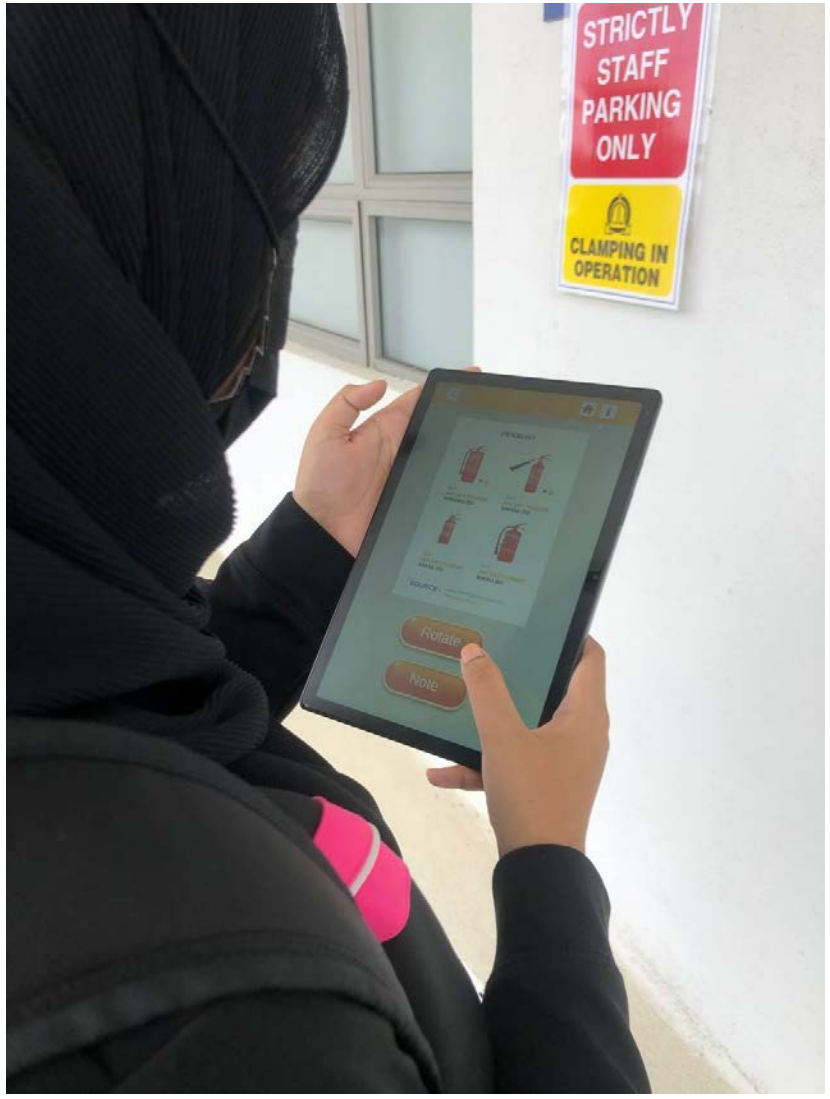
Name: NUR SYAZATUL ZULAIKHA BINTI NOR AZIZI
Phone Number: +60 11-5653 6854
Email: syazatulikaz@gmail.com

Date: 12 June 2023

No.	ID	Acceptance Criteria	Expectation Result	Actual Result	Pass / Fail	Inspection Type	Remarks
1.	ARFX001	Able to click all the button	All the button functions well	Indicate correct location	Pass	E	
2.	ARFX002	Rotate the fire extinguisher using the y-axis navigation	Successfully rotate the fire extinguisher using the y-axis navigation when clicking rotate button	Rotation against the y-axis	Pass	E	
3.	ARFX003	Displayed price information when clicking the note button	Successfully show price information when clicking the note button	Appear note when click	Pass	E	
4.	ARFX004	Able to scan the image targets for different fire extinguisher categories	Successfully scan the image targets for different fire extinguisher categories	Scan and display	Pass	E	
5.	ARFX005	Display category names and descriptions of the fire extinguishers	Successfully show category names and descriptions of the fire extinguishers	Display the correct category name and description	Pass	E	
6.	ARFX006	Correct 3D model for position and appearance	Successfully have a 3D model for position and appearance	Position of the 3D model in correctly	Pass	A	
7.	ARFX007	Interact with the simulation by shooting at the fire and balloon objects	Successfully Interact with the simulation by shooting at the fire and balloon objects	The boxes turn up the fire, and the ballon pulls over the water	Pass	E	3D model does not stick well at image target

8.	ARFX008	Able to scan the image target and access the contact information	Successfully scan the image target and access the contact information	Scan and display	Pass	E	
9.	ARFX09	Button question mark in contact can click well	Successfully click the button	Click and display information	Pass	E	
10.	ARFX010	Display the QR code and scan to get the image target in correctly	Successfully shows QR code and scan to get the image target in correctly	Appear the QR and scan.	Pass	E	
11.	ARFX011	Audio briefing for all methods functions well	Successfully display the audio briefing for all methods functions well	Appear sounds with the correct audio	Pass	E	
12.	ARFX012	Display animation simulations for pulling the pin, aiming, squeezing, and sweeping clearly	Successfully show animation simulations for pulling the pin, aiming, squeezing, and sweeping clearly	Animation and display information	Pass	A	More animation will look real
13.	ARFX013	Display quiz questions accurately	Successfully show quiz questions accurately	Appear the questions and answer options	Pass	E	
14.	ARFX014	Can click the options in quiz module	Successfully click the options in quiz module	Correct location	Pass	E	
15.	ARFX015	Display feedback for indicating wrong or correct answer	Successfully show feedback for indicating wrong or correct answer	Correct feedback	Pass	E	
16.	ARFX016	Display scoring system correctly		Correct score	Pass	E	

For inspection type: E-excellent, A-average, P-poor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MEEAR FIRE
Guide
FireARr
QUIZGUISHER
Exit

FUNCTIONALITY ACCEPTANCE TESTING (FAT)
AUGMENTED REALITY FIRE EXTINGUISHER APPLICATION FOR FIRE SAFETY TRAINING - MeeAR FIRE

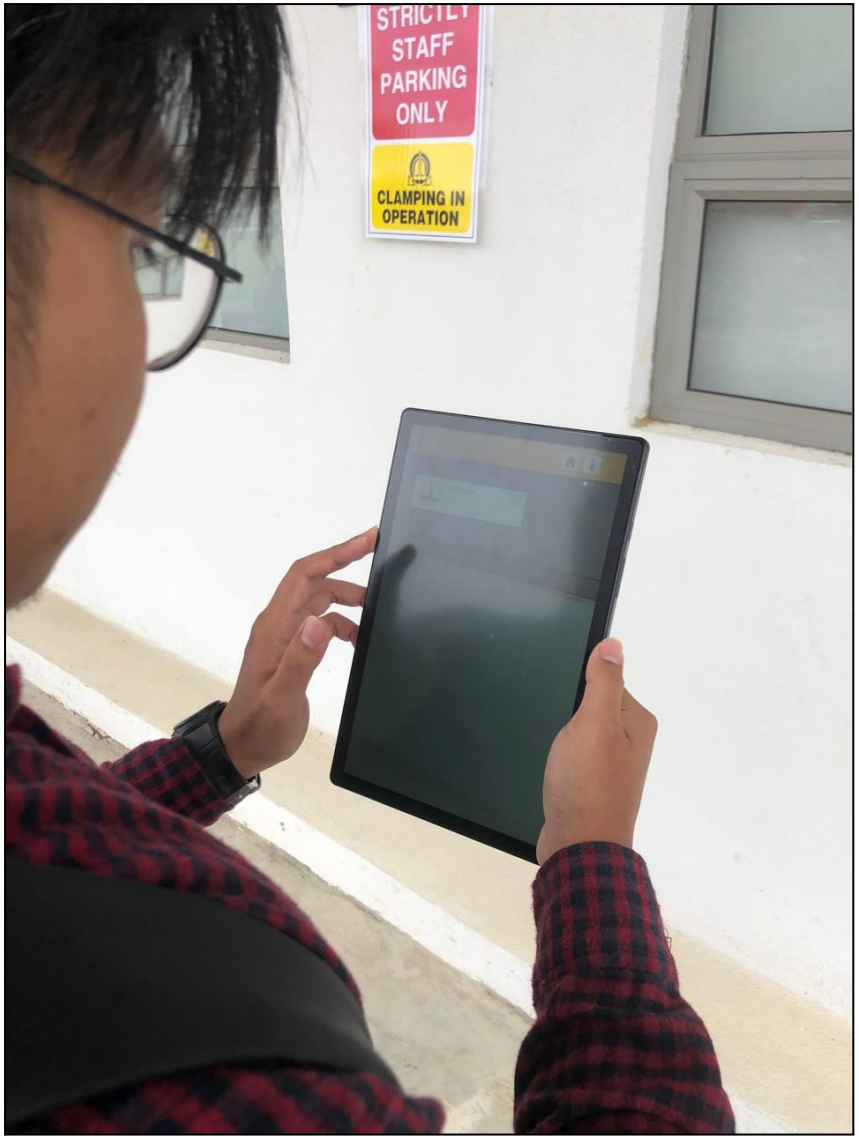
Name: MUHAMMAD HARIS TAUFIQ BIN NAZARUDIN
Phone Number: +60 11-1981 5918
Email: harisdotcom@gmail.com

Date: 12 June 2023

No.	ID	Acceptance Criteria	Expectation Result	Actual Result	Pass / Fail	Inspection Type	Remarks
1.	ARFX001	Able to click all the button	All the button functions well	Indicate correct location	Pass	E	
2.	ARFX002	Rotate the fire extinguisher using the y-axis navigation	Successfully rotate the fire extinguisher using the y-axis navigation when clicking rotate button	Rotation against the y-axis	Pass	E	
3.	ARFX003	Displayed price information when clicking the note button	Successfully show price information when clicking the note button	Appear note when clicking	Pass	E	
4.	ARFX004	Able to scan the image targets for different fire extinguisher categories	Successfully scan the image targets for different fire extinguisher categories	Scan and display	Pass	E	
5.	ARFX005	Display category names and descriptions of the fire extinguishers	Successfully show category names and descriptions of the fire extinguishers	Display the correct category name and description	Pass	E	
6.	ARFX006	Correct 3D model for position and appearance	Successfully have a 3D model for position and appearance	Position of the 3D model in correctly	Pass	E	
7.	ARFX007	Interact with the simulation by shooting at the fire and balloon	Successfully Interact with the simulation by shooting at the fire	The boxes turn up the fire, and the ballon pulls over the water	Pass	A	3D model does not stick well at image target

		objects	and balloon objects				
8.	ARFX008	Able to scan the image target and access the contact information	Successfully scan the image target and access the contact information	Scan and display	Pass	E	
9.	ARFX09	Button question mark in contact can click well	Successfully click the button	Click and display information	Pass	A	Should be call icon
10.	ARFX010	Display the QR code and scan to get the image target in correctly	Successfully shows QR code and scan to get the image target in correctly	Appear the QR and scan.	Pass	E	
11.	ARFX011	Audio briefing for all methods functions well	Successfully display the audio briefing for all methods functions well	Appear sounds with the correct audio	Pass	E	
12.	ARFX012	Display animation simulations for pulling the pin, aiming, squeezing, and sweeping clearly	Successfully show animation simulations for pulling the pin, aiming, squeezing, and sweeping clearly	Animation and display information	Pass	E	
13.	ARFX013	Display quiz questions accurately	Successfully show quiz questions accurately	Appear the questions and answer options	Pass	E	
14.	ARFX014	Can click the options in quiz module	Successfully click the options in quiz module	Correct location	Pass	E	
15.	ARFX015	Display feedback for indicating wrong or correct answer	Successfully show feedback for indicating wrong or correct answer	Correct feedback	Pass	E	
16.	ARFX016	Display scoring system correctly		Correct score	Pass	E	

For inspection type: E-excellent, A-average, P-poor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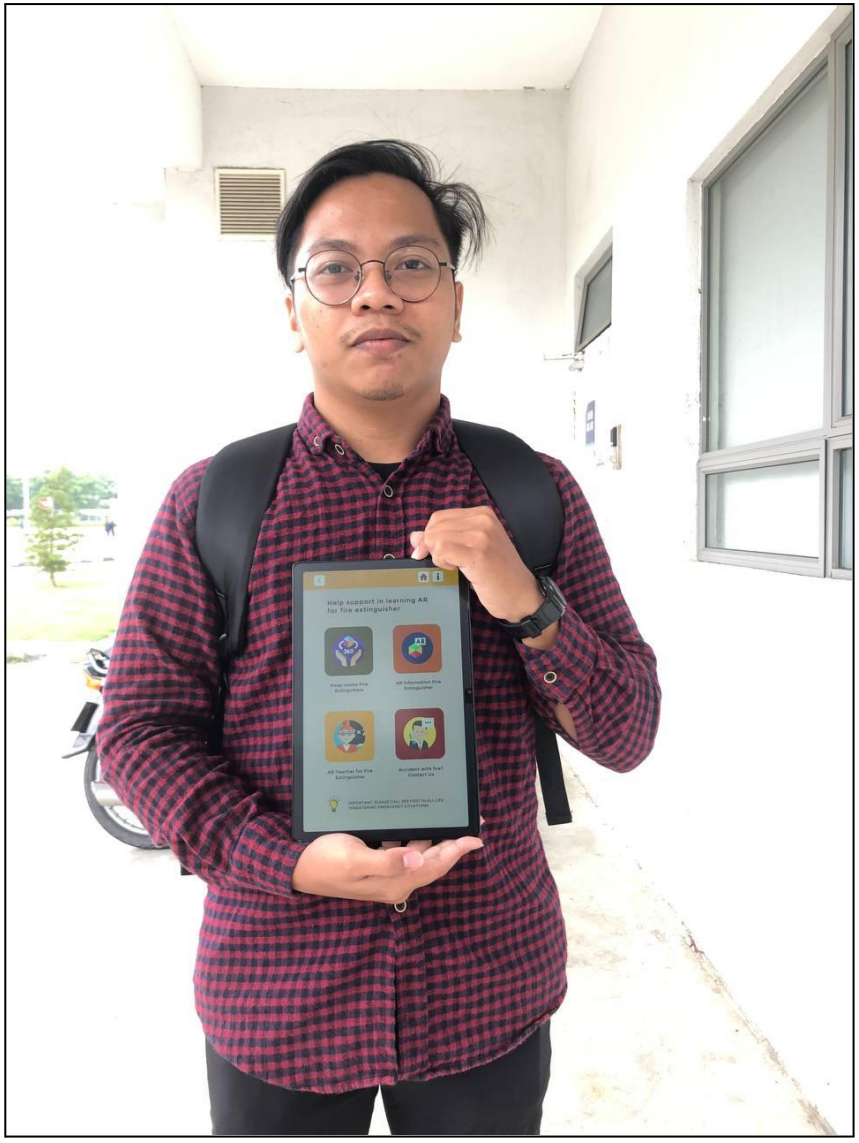
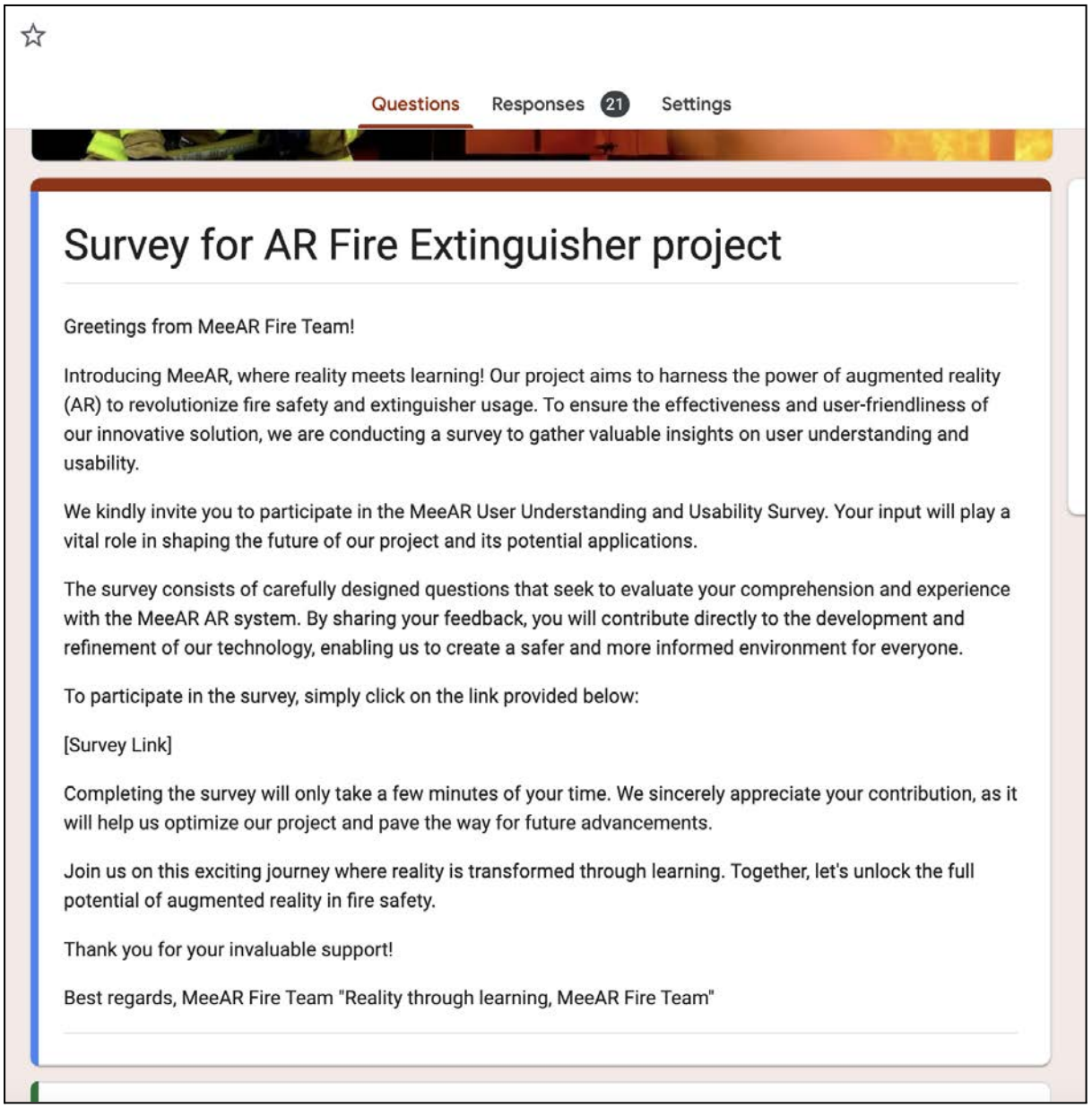

Help support in learning AR
for fire extinguisher

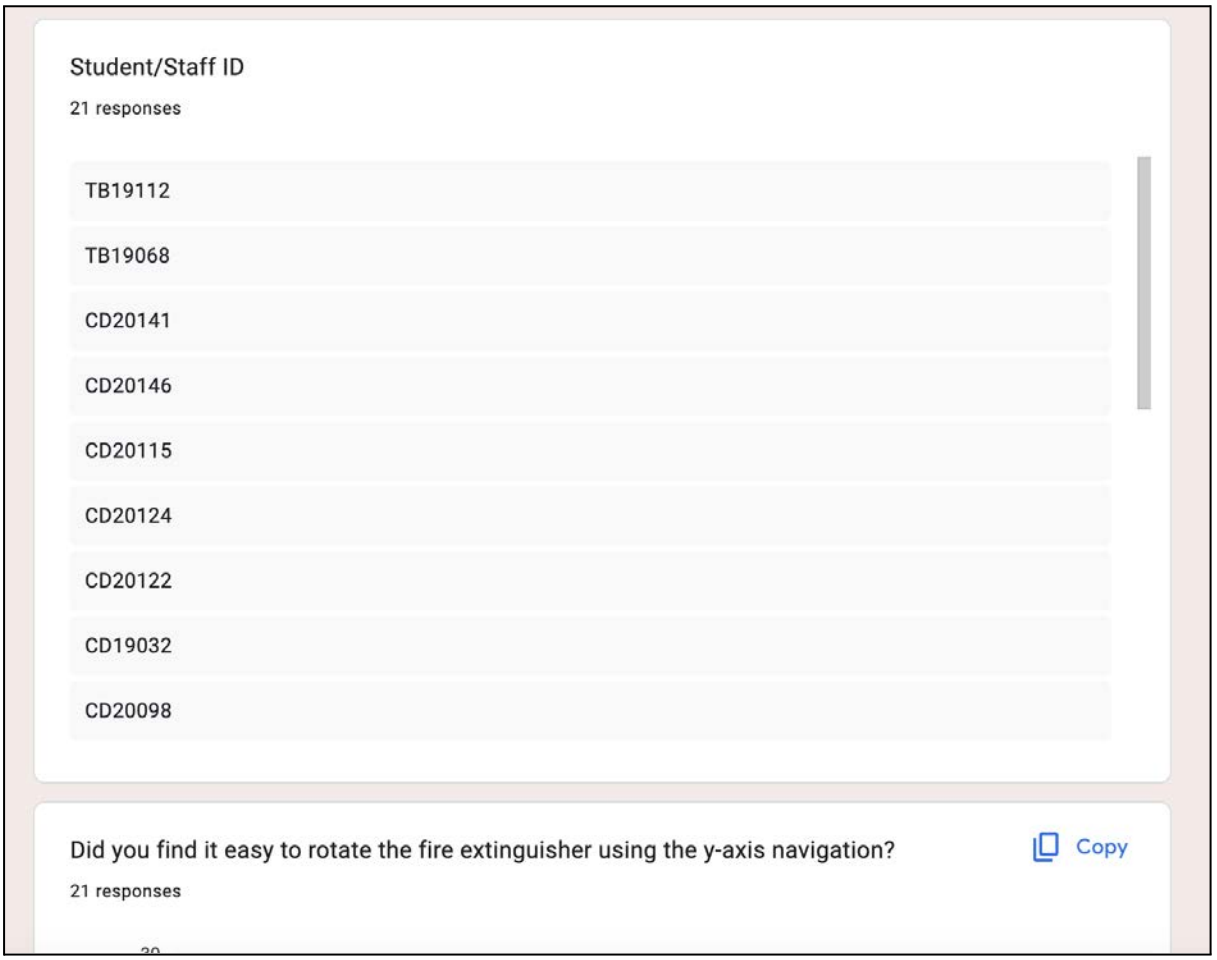
APPENDICES B

BETA TESTING TECHNIQUE

In conclusion, we have finished our beta testing by gathering feedback from 21 participants for our survey on the Augmented Reality Fire Extinguisher Application for Fire Safety Training - MeeAR FIRE. The response towards the solution has been positive, acknowledging its key features. Although there are a few areas that need improvement, overall it is a great achievement in the development process.



We collect student and staff IDs for this project, which is only from UMP institutions since the scope and target user cover of this institutions respectively.



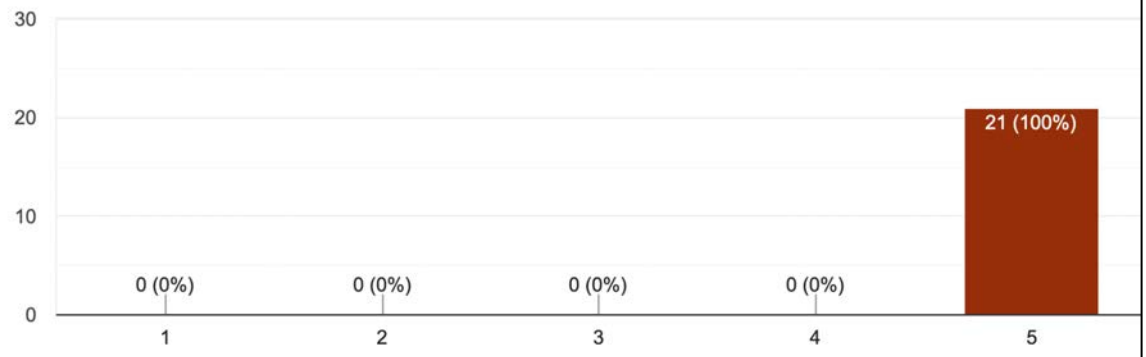
	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Student/Staff ID	Did you find it easy to rotate the fire extinguisher using the y-axis navigation?	Was the displayed price information of the fire extinguisher clear and helpful?	Did the price list for ABC powder provide you with a good understanding of the costs involved?	Were you able to easily scan the image targets for different fire extinguisher categories?	Did the displayed category names and descriptions of the fire extinguishers provide useful information?	Did the 3D model and usage instructions for each fire extinguisher enhance your understanding?	Did the simulation environment effectively resemble a classroom-like learning experience?	Was it clear how to interact with the simulation by shooting at the fire and balloon objects?	Was it easy to scan the image target and access the contact information?	Did the contact information provide you with relevant details for fire emergency situations?	Were the animation simulations for pulling the pin, aiming, squeezing, and sweeping clear and helpful?	Did the instruction structure and animations facilitate your understanding of using a fire extinguisher?	Did the quiz questions accurately test your knowledge of fire extinguishers?	Was the immediate feedback provided after answering each question helpful in understanding your performance?	Did the overall scoring system and quiz experience provide an engaging and informative learning experience?
2	TB19112	5	5	5	5	5	4	5	5	5	5	5	5	5	5	Strongly agree
3	TB19068	5	5	5	5	5	4	5	5	5	5	5	5	5	5	Strongly agree
4	CD20141	5	5	5	4	5	4	5	5	5	5	5	5	5	5	Strongly agree
5	CD20146	5	5	5	5	5	4	5	5	5	5	5	5	5	5	Strongly agree
6	CD20115	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Strongly agree
7	CD20124	5	5	5	5	5	4	5	5	5	5	5	5	5	5	Agree
8	CD20122	5	5	5	4	5	5	5	5	5	5	5	5	5	5	Strongly agree
9	CD19032	5	5	5	5	4	4	5	5	5	5	5	5	5	5	Strongly agree
10	CD20098	5	5	5	5	4	4	5	5	5	5	5	5	5	5	Strongly agree
11	CD20008	5	5	5	5	4	4	5	5	5	5	5	5	5	5	Agree
12	CD20105	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Agree
13	CD20049	5	4	5	5	5	5	5	5	5	5	5	5	5	5	Agree
14	CD20051	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Strongly agree
15	RC21164	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Strongly agree
16	RC21466	5	5	5	5	5	4	5	5	5	5	5	5	5	5	Agree
17	CB20078	5	4	5	5	5	4	5	5	5	5	5	5	5	5	Agree
18	CB21038	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Strongly agree
19	CB21072	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Agree
20	CC18283	5	5	4	5	5	4	5	5	5	5	5	5	5	5	Agree
21	A186251	5	5	5	4	5	4	5	5	5	5	5	5	5	5	Agree
22	KH22026	5	5	5	5	5	5	5	5	5	5	5	5	5	5	Strongly agree
23																

For linear scale: 1-Worst, 5-Excellent

Here is a link for further review:
https://docs.google.com/spreadsheets/d/10t2kMZVbO4C9DdMDXhllYQgktJqYRW4HwrpWbN2m6ww/edit?usp=sharing

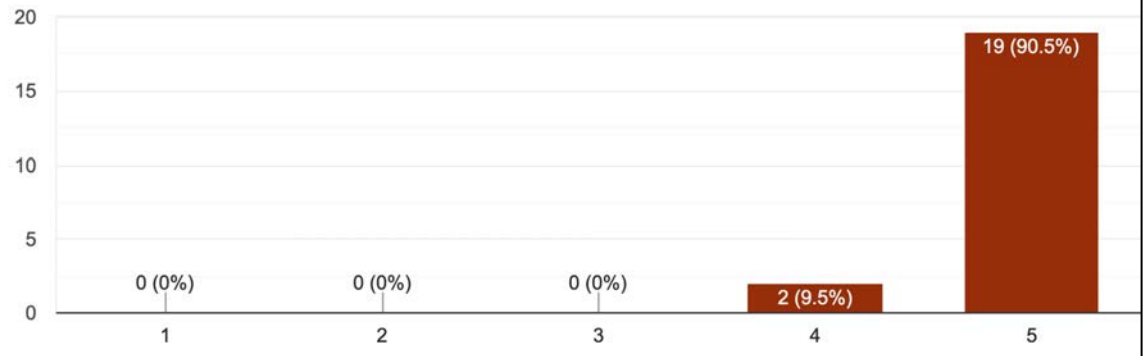
Did you find it easy to rotate the fire extinguisher using the y-axis navigation?

21 responses



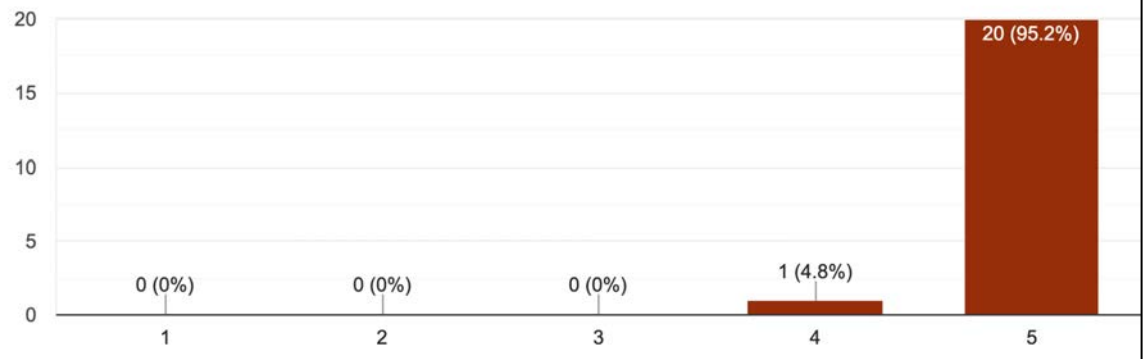
Was the displayed price information of the fire extinguisher clear and helpful?

21 responses



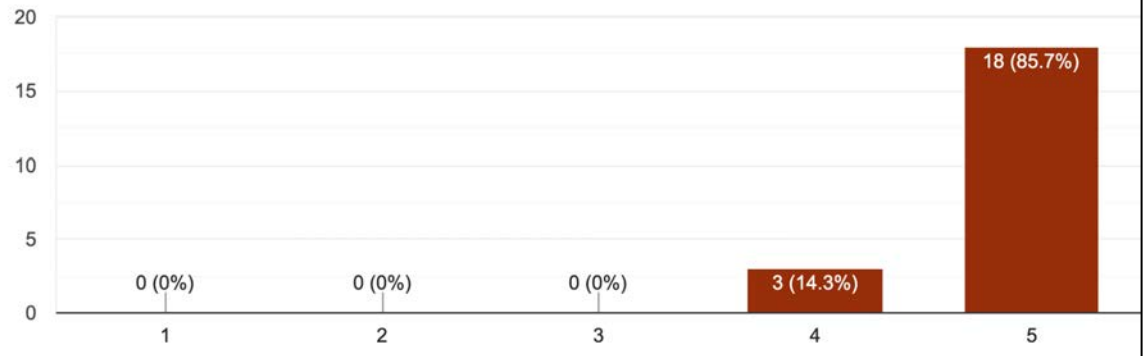
Did the price list for ABC powder provide you with a good understanding of the costs involved?

21 responses



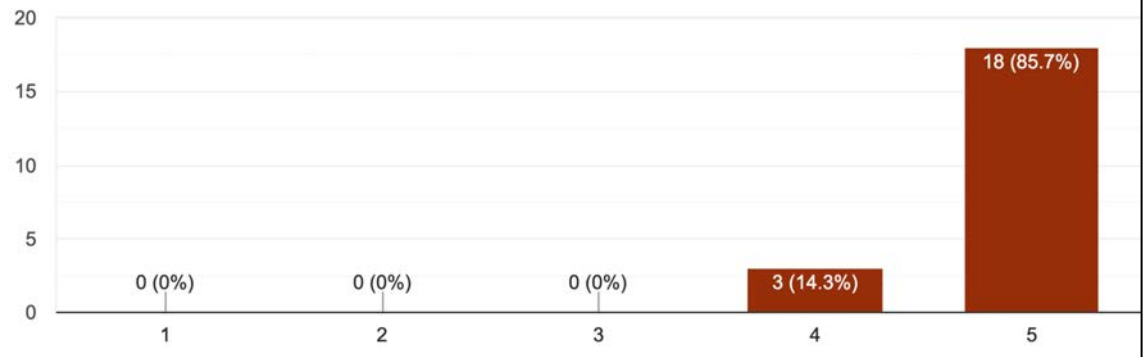
Were you able to easily scan the image targets for different fire extinguisher categories?

21 responses



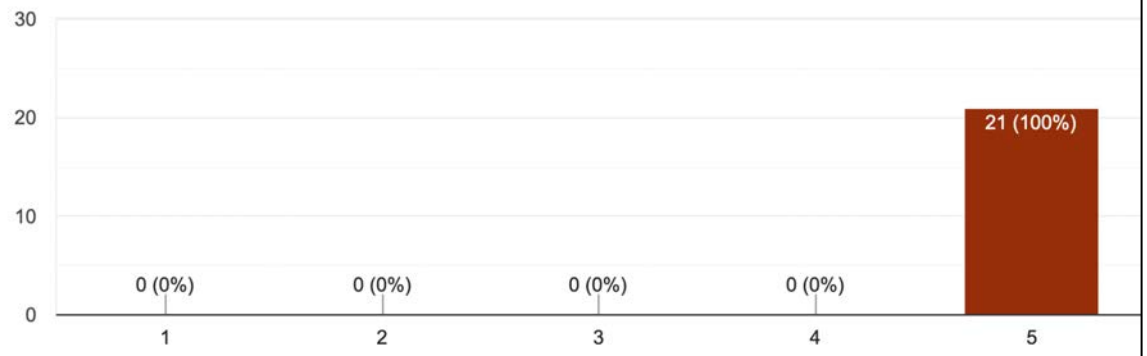
Did the displayed category names and descriptions of the fire extinguishers provide useful information?

21 responses



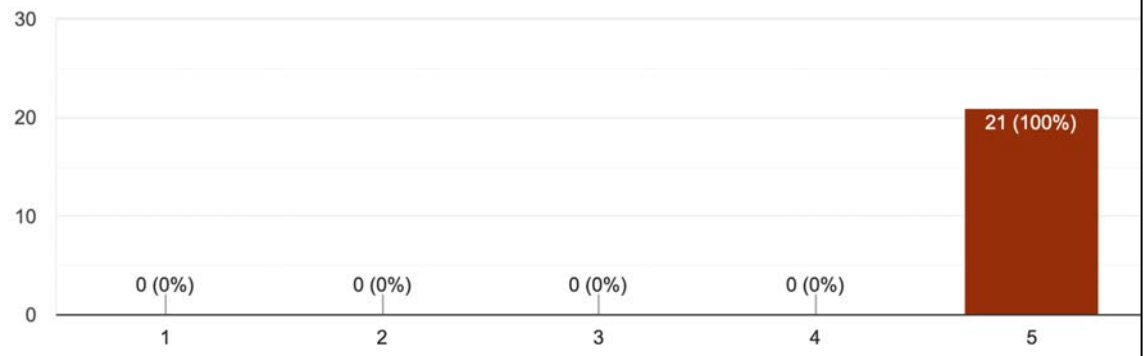
Did the simulation environment effectively resemble a classroom-like learning experience?

21 responses



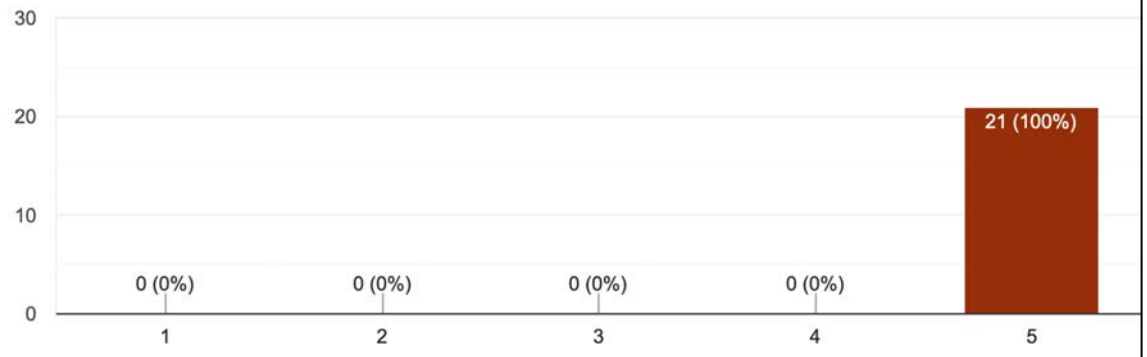
Was it clear how to interact with the simulation by shooting at the fire and balloon objects?

21 responses



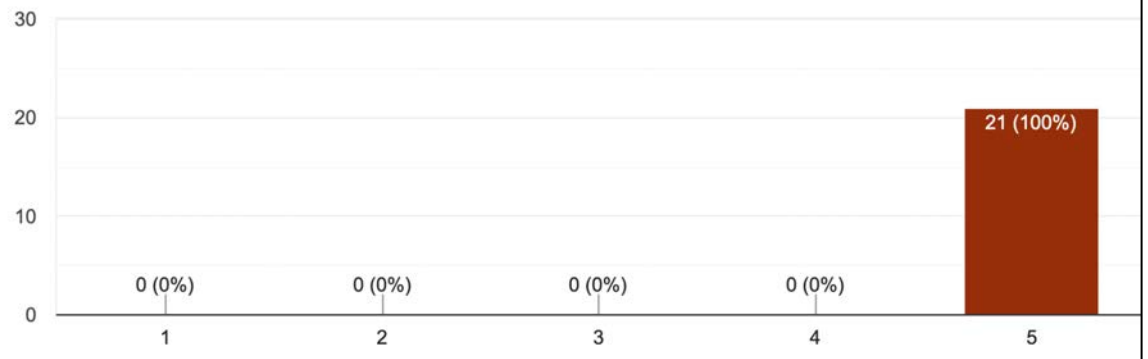
Was it easy to scan the image target and access the contact information?

21 responses



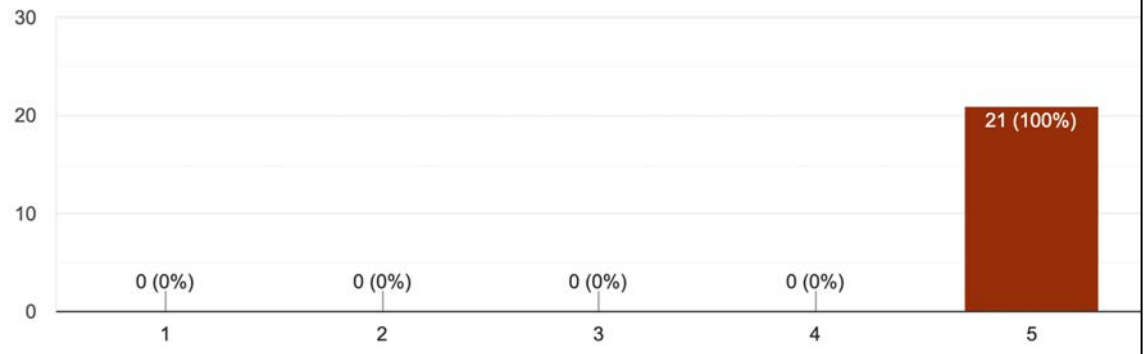
Did the contact information provide you with relevant details for fire emergency situations?

21 responses



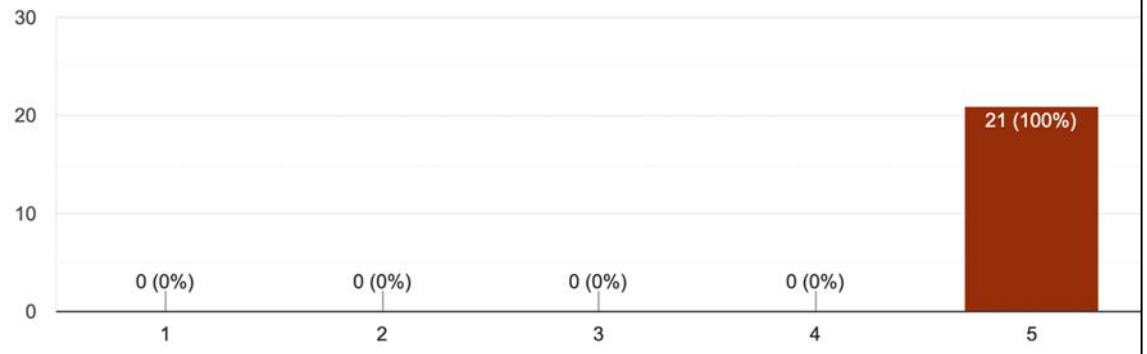
Were the animation simulations for pulling the pin, aiming, squeezing, and sweeping clear and helpful?

21 responses



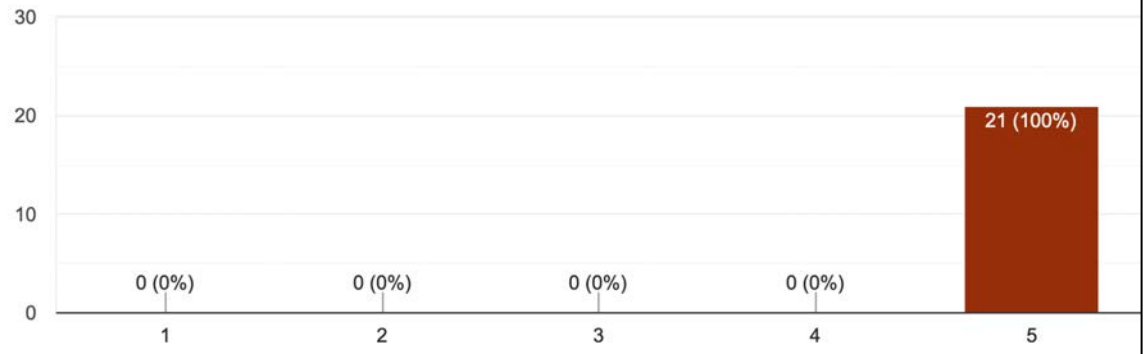
Did the instruction structure and animations facilitate your understanding of using a fire extinguisher?

21 responses



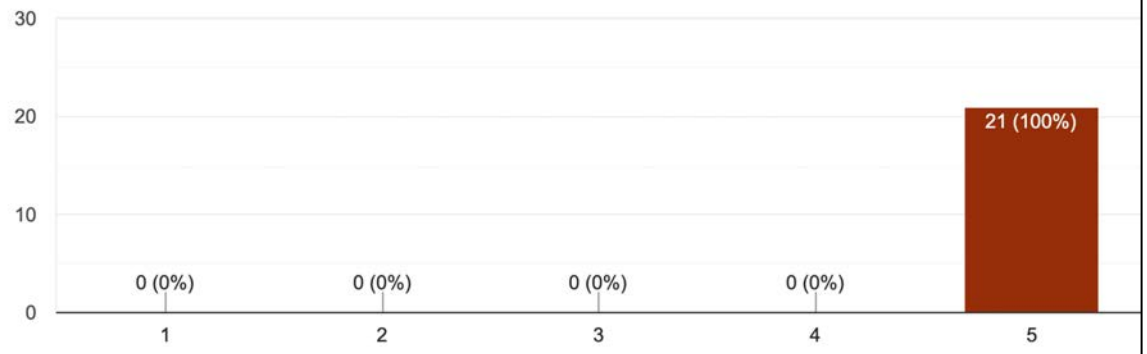
Did the quiz questions accurately test your knowledge of fire extinguishers?

21 responses



Was the immediate feedback provided after answering each question helpful in understanding your performance?

21 responses



Did the overall scoring system and quiz experience provide an engaging and informative learning experience?

21 responses