



German International University
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Treasure Hunt AR-Game Report

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Chapter 1

Introduction

The design and implementation decisions we made for our Augmented Reality (AR) game—which was created with Unity and Vuforia—are described in detail in this report. With the help of virtual prizes, image targets, and clues to locate more targets, players can expect an immersive experience from this game. The major goal is to identify every picture target in order to gather all hidden prizes.

Chapter 2

Game Design

2.1 Concept and Objectives

The core concept of the game revolves around using AR technology to create a treasure hunt experience. Players use their device's camera to scan for image targets in their environment. Upon detecting a target, a 3D object appears, and players can collect this virtual treasure. Each successful detection reveals a hint for the next target, guiding players through the game until all treasures are collected.

2.2 User Interface

The user interface (UI) is designed to be simple and intuitive:

- **Start and Instructions:** Allows players to read instructions and start the game.
- **Score Display:** Shows the current score and the number of remaining targets.
- **Hint Text:** Provides clues to the location of the next target.
- **Collect Button:** Appears when a target is detected, allowing players to collect the treasure.
- **Quit and Exit Buttons:** Allow players to exit the game.

2.3 Implementation choices

Unity was chosen as the development platform due to its robust support for AR development and its extensive documentation and community support. Vuforia was selected for its powerful image recognition capabilities and seamless integration with Unity.

1. **Image Targets:** Vuforia's image target feature is used to detect predefined images in the real world. These targets are linked to corresponding 3D models that appear upon detection. We used a database to save our 7 image targets.
2. **3D Models:** Unity's asset system is used to manage and display 3D models representing the virtual treasures. The following are links for the assets (they are not just 1 object, but many objects in one package):
 - <https://assetstore.unity.com/packages/3d/props/potions-coin-and-box-of-pandora-pack-71778>
 - <https://assetstore.unity.com/packages/3d/props/medieval-gold-14162>
 - <https://assetstore.unity.com/packages/3d/props/interior/treasure-set-free-chest-72345>
3. **Self-generated 3D models:** I used a cylinder and a cube to model a coin and a box. I used materials downloaded online to give the effect of a real coin and treasure box.

2.4 Script Developement

The game's functionality is managed through a custom C# script. Key scripts include:

1. **Controller Script:** Manages game logic, including target detection, score updating, and hint management. In the script we control the following:
 - Collect button click: update the score text, display next hint
 - Quit and exit button click: exit the game
 - Start and instructions page: display the instructions and start the game
 - Image detection: displaying the collect button
2. **UI Management:** Handles the display and update of UI elements like score, hints, and buttons. Also updates the colors.
3. **Detection Handling:** Ensures accurate detection and prevents repeated detections of the same target.

Chapter 3

Challenges

- **Handling Repeated Detections:** One challenge was preventing repeated detections of the same target. This was addressed by introducing a pause in detection for 2 seconds after each successful detection, ensuring that the same target isn't immediately detected again.
- **Audio Playback:** To ensure audio feedback is played correctly, the audio source is stopped and restarted each time a target is detected. This guarantees that the audio plays in full for each detection event.
- **Detecting the Wrong Image in the Sequence:** In order to detect images in the correct sequence, if an image is detected but it's not the one belonging to the hint, the collect button does not appear which prompts the user to find another image target. We do this by comparing the detected target with the one in the array at the current index.
- **Application Quit:** Implementing a graceful exit from the application proved challenging, especially in the editor where `Application.Quit()` does not behave as expected because we are playing in Unity Editor. The solution involved adding UI buttons to manage quitting the game and ensuring the game state is correctly updated before calling quit like the following line of code:
`UnityEditor.EditorApplication.isPlaying = false;`

Chapter 4

Questionnaire

We created a questionnaire directed towards the users who tried the game. We sent the questionnaire link to the participants after they were done testing our game and collected their response. The following is a screenshot of the questionnaire from google forms. Our questionnaire concentrated on first asking the users whether they used AR before, and then asking about their experience using our game. At the end we asked the participants to give us any feedback and improvement suggestions. The screenshots are on the next page:

AR Game Feedback Questionnaire

Thank you for taking the time to provide your feedback on our Treasure Hunt AR game. Your insights and suggestions are invaluable in helping us improve and create a better gaming experience for everyone.

As part of our AR game, we are required to get feedback on your game experience. Please provide us with all answers to the questions. Everything will be collected anonymously. It will only take 2 mins of your time.

Your feedback will help us understand what you loved about the game, what challenges you faced, and how we can make the game even more enjoyable.

[Sign in to Google](#) to save your progress. [Learn more](#)

* Indicates required question

What is your age? *

☐ 7-14

☐ 15-19

☐ 20-25

☐ 26-35

☐ 35+

What is your gender? *

☐ Female

☐ Male

Did you play traditional Treasure-Hunt before? *

☐ Yes

☐ No

Figure 4.1: Questionnaire pic 1

Did you play traditional Treasure-Hunt before? *

☐ Yes

☐ No

Did you use any AR tools before? *

☐ Yes

☐ No

On a scale from 1 to 5(worst to best), how easy did you find the navigation using *
your device camera?

	1	2	3	4	5	
worst	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	best

On a scale from 1 to 5(worst to best), how easy were the interactions with the *
treasures?

	1	2	3	4	5	
worst	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	best

On a scale from 1 to 5(worst to best), how did you like the sounds? *

	1	2	3	4	5	
worst	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	best

Figure 4.2: Questionnaire pic 2

Did you play the game until you won? Why? (Write your answer in the space provided) *

Your answer _____

If you could change one thing about the game, what could it be? *

☐ change the images that must be detected

☐ add more sounds

☐ add more clues

☐ Other: _____

Were the images easy to detect given the hints provided? *

☐ Yes

☐ No

What is your favourite thing about the game? *

☐ the objects displayed

☐ the sounds when we collected something

☐ the hints that help us detect the image

☐ the win sound at the end

☐ Other: _____

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Google Forms

Figure 4.3: Questionnaire pic 3

Chapter 5

Analysis

We distributed our form to 5 different people from 5 age groups and different genders to test out our game. In this section we explain our results:

5.1 Demographics

1. **Age:** Our sample had an age range of 28 years with the modal class being 15-19 years of age. This allowed us to test across a wide spectrum of users each range having its own unique needs and challenges.

What is your age?
5 responses

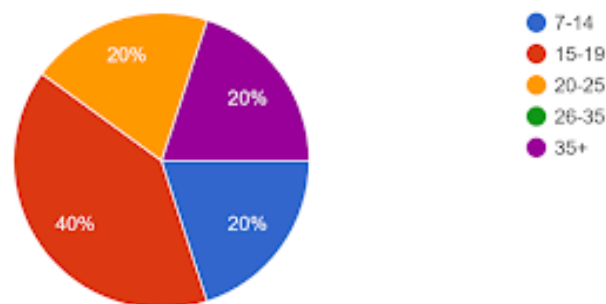


Figure 5.1: Age

2. **Gender:** As for gender our split was mostly female but seeing as there were only 5 people the split can still be considered as pretty evenly distributed.

What is your gender?

5 responses

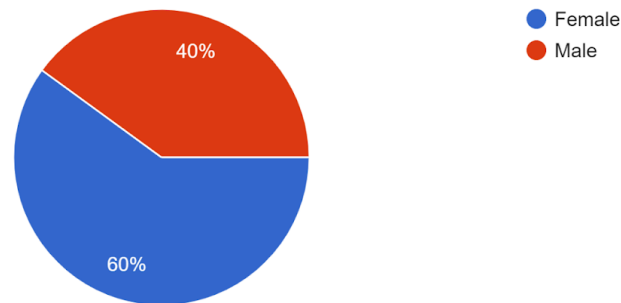


Figure 5.2: Gender

5.2 Previous Experience

1. **Treasure-Hunt:** Our sample was mostly unfamiliar with the traditional treasure hunt task which highlights a need we must account for in our application.

Did you play traditional Treasure-Hunt before?

5 responses

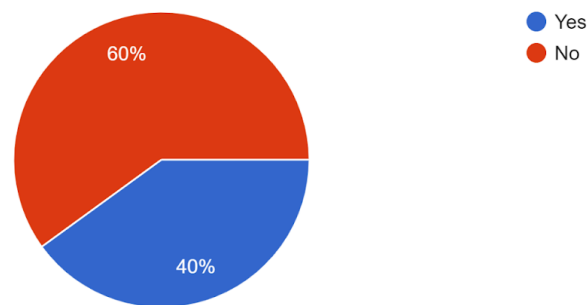


Figure 5.3: Treasure hunt familiarity

2. **Use of AR-Tools:** Given the growing popularity of AR Technology it is unsurprising that most of our sample would have had some experience with AR Tools, this is important to us as developers because it can help us highlight issues with our game and or strengths more accurately by having something to compare to.

Did you use any AR tools before?

5 responses

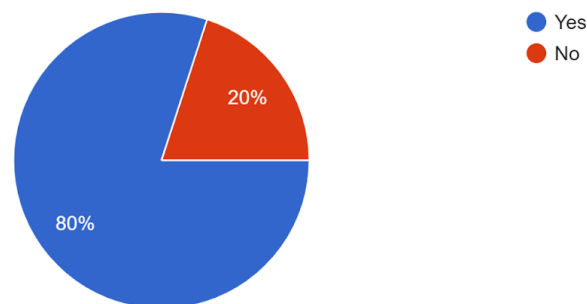


Figure 5.4: Use of AR Tools

5.3 Evaluation of our Game

We asked our users a series of questions to help them evaluate their experience of our AR Project. For our scale questions we used a 1-5 Likert Scale with 1 being the least/worst and 5 being the most/best. We chose this scale because it's the most universal and widely accepted and this would help reduce confusion and increase the accuracy of our answers. We asked users about 3 components in this fashion: ease of navigation, ease of interaction, sound preference.

1. **Ease of navigation:** Our data was skewed towards 4 and 5 with a mean value of 4.4, a median of 4 and a mode of 4. This is a good indication of our game's ease of navigation which is important for user engagement. However, it can be improved.

On a scale from 1 to 5(worst to best), how easy did you find the navigation using your device camera?

5 responses

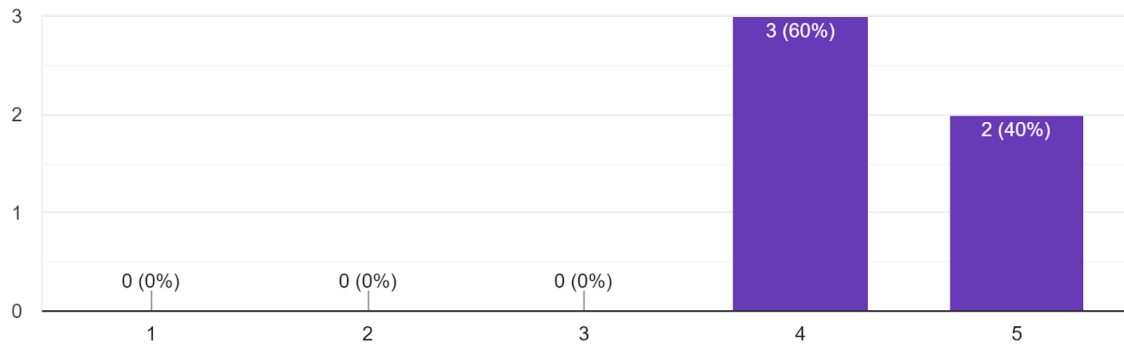


Figure 5.5: Ease of navigation

2. **Ease of interaction:** Here we were testing how easy it is to collect and interact with the treasure. Once again the data was skewed toward the higher end of the scale, with a mean of 4.6, a median of 5 and mode of 5. This is a good indication of our design and we can attribute this to the use of a collect button that helps users collect the treasure.

On a scale from 1 to 5(worst to best), how easy were the interactions with the treasures?

5 responses

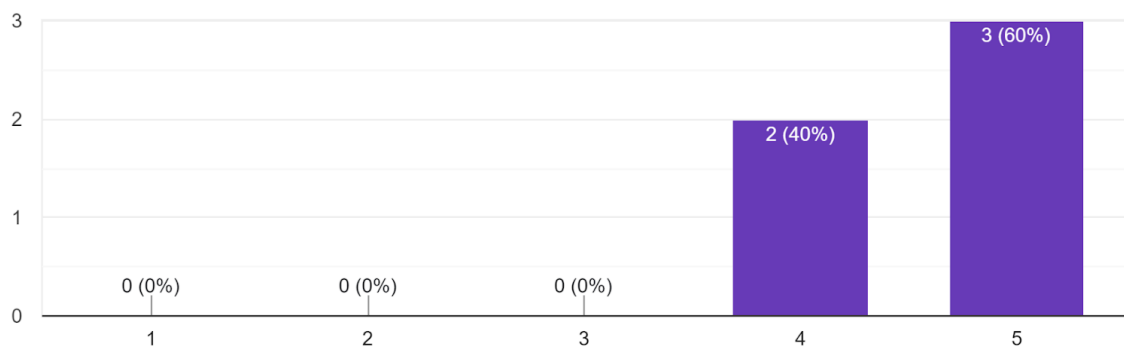


Figure 5.6: Ease of interaction

3. **Sound preference:** Finally we asked users to rate the sound effects we had used for item collection and winning. The sounds are used as auditory indicators so their

intention is more about increasing engagement and helping users navigate through the game. The results tended towards the upper end of the scale but less so when compared to the other 2 test variables. The mean was 4.2, median 4 and it was bi-modal with 4 and 5 as the modes. While this is still quite high, subsequent results show that this area can be improved.

On a scale from 1 to 5(worst to best), how did you like the sounds?

5 responses

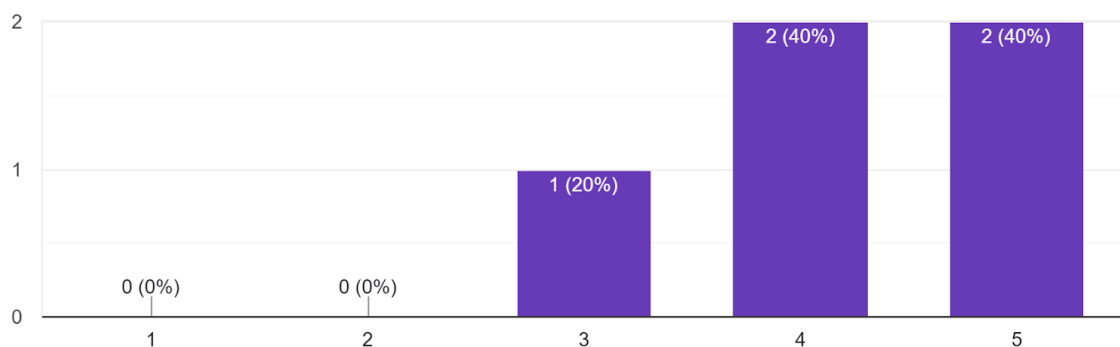


Figure 5.7: Sound preference

- User Understanding:** We asked users if they were easily able to find the correct image given the hints. This tested the clarity of our hints and their relationship to the images we provided. The answer was overwhelmingly yes, which indicates a strong relationship between the hints and the provided images and a clarity and conciseness in the language used to make the hints. However, this may also indicate that our version was not challenging enough to users and this can be built on.

Were the images easy to detect given the hints provided?

5 responses

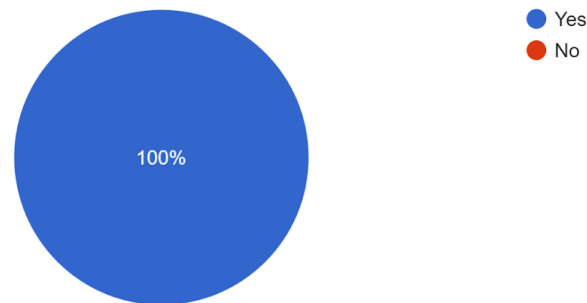


Figure 5.8: User Understanding

5. **Features of Interest:** Here we simply wanted to find out what users did or did not enjoy while playing our game, we asked them to pick both their favorite and least favorite features of the game to find out which of our components were the strongest and weakest from the user perspective. Most users enjoyed our use of hints which could be because they were easy to detect as found below.

What is your favourite thing about the game?

5 responses

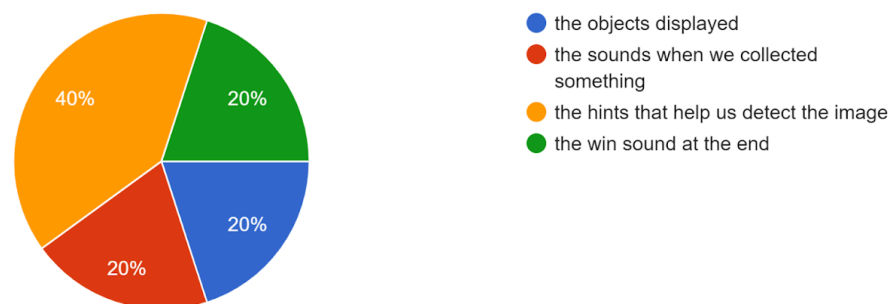


Figure 5.9: Features of Interest

6. **Improvements:** Here we see that most users voted to add more sound effects to the game which marks it as an important cue for users in terms of accessibility and engagement.

If you could change one thing about the game, what could it be?

5 responses

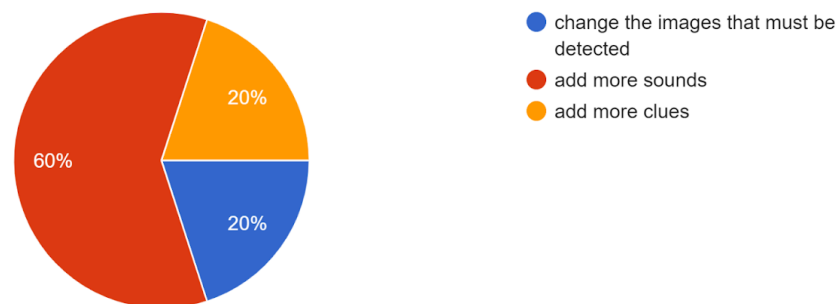


Figure 5.10: Improvements

5.4 Open-ended question

1. **Open-ended:** Finally, we asked users if they finished the game completely and asked them to explain why. This helped us find out more valuable insights about user engagement and the game overall. Users unanimously said that they did finish the game till the end which suggests that the game is not too long and or difficult as well as engaging as users didn't feel the need to leave it midway. The reasons cited were different however they mostly had to do with excitement over the end result and finding all the treasures. These were the exact responses:

Did you play the game until you won? Why? (Write your answer in the space provided)	
Age	Response
20-25	Yes because it was exciting to see the end result
15-19	The game was exciting and wanted to find all treasures
35+	Yes. I wanted to try and find all the treasures.
7-14	yes, i wanted to see the final prize
15-19	Yes. I wanted to collect them all.

Figure 5.11: Open ended question results

Overall, we can conclude that our game was easy and engaging given our sample testers and there is room for improvement in terms of sensory engagement and difficulty.

5.5 Strengths and weaknesses

As for our own evaluation of the game we came up with 2 strengths and 2 weaknesses based on our experience and the results above:

Strengths:

- The game is easy to use and navigate
- Our clues were well written

Weaknesses:

- Our game was too short and could be extended to have multiple levels of difficulty based on age and experience with treasure hunts as well as AR Tools.
- We should use more sensory engagement via audio Moreover we need to collect more data to accurately identify the needs of our users to guide us in developing a better product.

Chapter 6

Conclusion

The augmented reality game creates a fun and engaged user experience by skillfully fusing treasure hunt gameplay with image target recognition. Design decisions were made with user interaction, robust functionality, and simplicity in mind. The integration made use of Vuforia's and Unity's advantages to produce a fluid and captivating augmented reality game. Potential future enhancements could include adding more targets, improving the user interface, and adding more sounds.