CMPE 492

Senior Project 2

Final Report

“VR PROJECT BLUE”

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1.Introduction

1.1 Purpose

The purpose of this report is to provide an overview of VR Project Blue focusing on its architecture and design as well as the broader impact of the engineering solutions, on a global and social level. The intention behind this document is to communicate the aspects of the project to stakeholders' members of the project team and potential users.

1.2 Scope

This report covers the concluding phases of VR Project Blue providing information about its system architecture, design decisions and the wider effects brought by the engineering solutions implemented. Moreover, it delves into the social implications of this virtual reality experience highlighting its significance, in entertainment domains.

2. System Overview

2.1 Project Background

VR Project Blue is an immersive Virtual Reality (VR) serious game designed to provide a unique blend of entertainment and education, with a focus on cybersecurity principles. Developed for VR platforms, the project aims to engage users through educational puzzles and gameplay mechanics, offering an interactive and informative experience.

2.2 Key Features

Educational Puzzles: Integrating fundamental cybersecurity knowledge into interactive puzzles.

VR Gameplay Mechanics: Incorporating immersive interactions like holding and throwing objects.

Compelling Cybersecurity Storyline: Presenting a captivating narrative set in the realm of cybersecurity.

2.3 Target Audience

Individuals interested in cybersecurity education.

VR enthusiasts seeking an engaging and educational experience.

2.4 Platforms

Virtual Reality (VR) platforms.

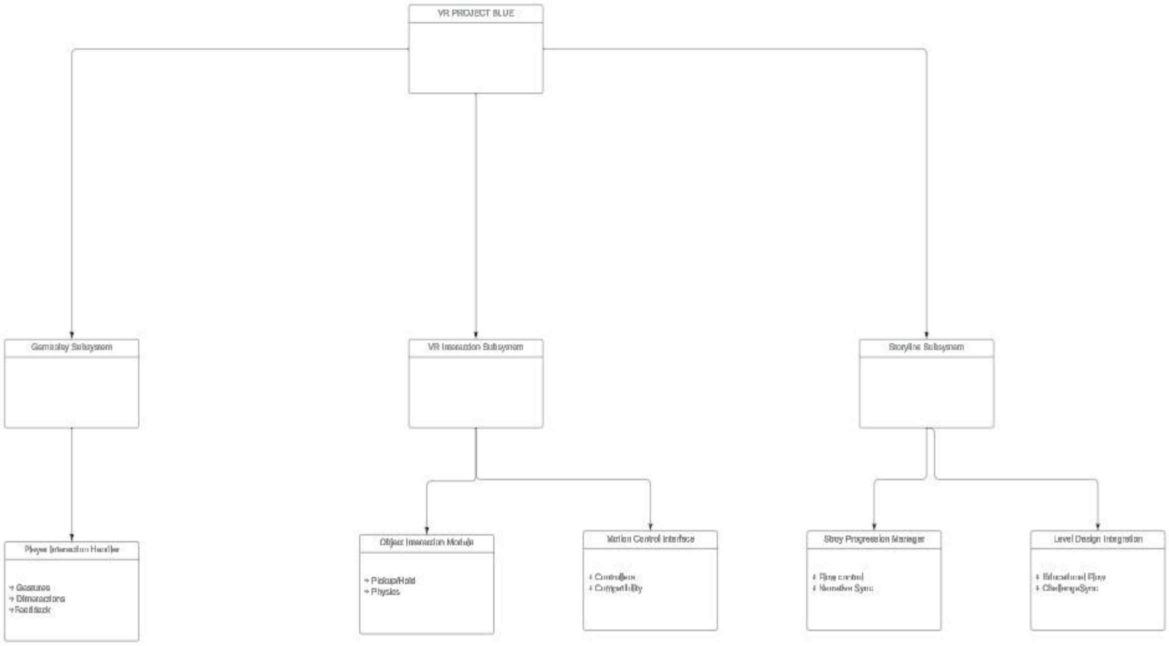
3. Final Architecture and Design

3.1 Overview

The final architecture and design of VR Project Blue represent a culmination of meticulous planning, iterative development, and a commitment to delivering a seamless user experience. This section provides an overview of the overarching structure and design principles that shape the VR environment.

3.2 Subsystem Decomposition

VR Project Blue is structured into several key subsystems, each contributing to the overall functionality of the VR experience. These subsystems include:



3.2.1 Gameplay Subsystem:

Player Interaction Handler:

Interprets user gestures and actions, such as hand movements and gestures using VR controllers.

Incorporates feedback mechanisms to enhance user engagement, providing a responsive and immersive experience. Collaborates with the VR Interaction Subsystem for seamless integration of object interactions within the puzzles.

3.2.2 VR Interaction Subsystem:

Object Interaction Module:

Enables users to pick up, manipulate, and interact with virtual objects relevant to the cybersecurity narrative. Incorporates physics-based interactions for a realistic feel, enhancing the overall immersive experience. Supports a variety of objects, from cybersecurity tools to virtual representations of challenges. Motion Control Interface:

Connects with VR controllers to accurately capture and translate real-world movements into virtual interactions. Implements gesture recognition for intuitive control, allowing users to navigate the virtual environment seamlessly. Adapts to different VR hardware configurations for broad compatibility.

Haptic Feedback System:

Enhances user immersion by providing tactile feedback in response to virtual interactions. Differentiates haptic feedback based on the type of interaction, adding a layer of realism. Adjusts intensity and duration of haptic feedback to match the context, reinforcing the educational and gaming experience.

3.2.3 Storyline Subsystem:

Story Progression Manager:

Guides players through a cohesive narrative, ensuring a balanced blend of storytelling and educational content. Triggers events and challenges based on player progression, adapting the storyline dynamically. Collaborates with the Gameplay Subsystem to synchronize educational content with narrative elements.

Character AI Module:

Creates virtual characters with realistic behaviors and interactions relevant to the cybersecurity theme. Adapts character responses based on user choices, adding a dynamic element to the narrative. Enhances the overall user experience by providing a sense of context and immersion through virtual characters.

Level Design Integration:

Aligns educational challenges with the storyline, ensuring a seamless integration of cybersecurity concepts. Creates diverse and engaging levels that progressively introduce and reinforce cybersecurity principles. Collaborates with the Puzzle Manager to synchronize puzzle placement with narrative events.

3.2.4 User Interface (UI) Subsystem:

HUD (Head-Up Display):

Displays critical information, such as scores, objectives, and feedback, without obstructing the user's view. Adapts dynamically to the VR environment, optimizing content visibility based on user interactions. Maintains a minimalist design to avoid overwhelming the user with information.

Menu System:

Facilitates intuitive navigation through settings, level selection, and additional features. Implements VR-friendly menus with interactive elements, enhancing user accessibility. Integrates with the Story Progression Manager to provide a seamless transition between levels and narrative events.

Tutorial Overlay:

Offers on-screen guidance and instructions to assist users in understanding gameplay mechanics.

Adapts dynamically based on user progress, providing contextual tutorials as needed.

Enhances the onboarding experience by minimizing the learning curve for VR interactions and educational elements.

By detailing each subsystem's components and functionalities, we aim to provide a comprehensive understanding of the intricate architecture and design principles within VR Project Blue. These subsystems work collaboratively to create an immersive, educational, and entertaining VR experience for users.

4. Impact of Engineering Solutions

The impact of engineering solutions in VR Project Blue extends beyond technical considerations, encompassing both global and social dimensions. This section examines the broader implications of the project's engineering decisions, highlighting the positive influence on a global scale and the societal changes that may result.

4.1 Global Impact

VR Project Blue contributes to the global landscape by addressing key challenges and opportunities: Cybersecurity Education: The project fosters global awareness and knowledge of cybersecurity principles, contributing to the collective effort to enhance digital security on a global scale. Technological Advancement: By pushing the boundaries of VR technology, the project advances the broader field of immersive experiences, influencing the evolution of virtual environments and their applications globally. Cross-Cultural Engagement: Through a captivating storyline and educational content, VR Project Blue promotes cross-cultural understanding, encouraging diverse audiences worldwide to engage with and learn from the VR experience.

4.2 Social Impact

The social impact of VR Project Blue is multifaceted, influencing individuals and communities in various ways:

Education and Empowerment: The project empowers individuals by providing accessible and engaging cybersecurity education, contributing to a more informed and digitally literate society.

Inclusivity: VR Project Blue aims to be inclusive by ensuring accessibility features, accommodating users with different abilities and backgrounds. This inclusivity promotes diversity and equal participation in the VR experience.

Community Building: The shared experience of VR Project Blue creates opportunities for community building among users interested in cybersecurity education, fostering a sense of belonging and collaboration.

Ethical Considerations: As the project delves into the realm of cybersecurity, it emphasizes ethical considerations, encouraging responsible and ethical behavior in the digital space.

In conclusion, the impact of engineering solutions in VR Project Blue transcends technical excellence, influencing global perspectives on cybersecurity and fostering positive societal changes. The project stands as a testament to the potential of immersive technologies to shape a more informed, connected, and secure world.

5-Contemporary Issues

5.1-Finding suitable assets for the game.

In order for our game to visually impress the user, the assets we would use for the game had to include the player in the atmosphere of the game. With this in mind, we had a hard time finding assets for our game that would not disrupt the integrity of the game. It was very important for us that our office and room scenes were in harmony within the game. For this reason, we did a lot of research to find assets that would not disrupt this harmony. Although finding suitable assets was difficult for us at first, we were able to find the assets we wanted in the end.

5.2-Gameplay mechanics and globality.

It was very important for us during the production phase of the game that our game mechanics were suitable and understandable for every audience. Especially since our game is an educational game, we wanted to ensure that it entertains while educating. We wanted to design our mechanics in this context so that this would not be difficult for the user and would be understood by the entire user base. We thought about making mechanics that could be understood by the entire user base, and we wanted to develop mechanics that could adapt the Player to our game. Although we had difficulty integrating the mechanics we wanted into the game at first, we were eventually able to integrate these mechanics into our game. In this way, the mechanics we used in the game could be easily understood and implemented by the entire user base.

6-Use of Libraries and Resources

6.1-OpenXR

“XRController (Action based) [1]”: interprets feature values on a tracked input controller device using actions from the input system to create XR Interaction states, like Select. It also applies to a tracked device's current Pose value when transforming the GameObject.
The Select Action, Activate Action, and UI Press Action properties have corresponding values for Select Action, Activate Action, and UI Press Action. The actions in these activities are of two different types: button actions for the former and optional value type actions for the latter. The component reads if the choose action is performed once every frame to ascertain whether the select interaction state is active. The float value from the select action value is also recorded. If there is no value set for the Select Action, the float value will be read from the Select Action. Again, the Activate and UI Press actions follow this process.

“XRInteractionManager [2]”: Interactors and interactable objects in a scene are connected through the Interaction Manager. There can be multiple Interaction Managers, each with its own set of valid Interactors and Interactable Objects. At wakeup time, Interactors and Interactable Objects register themselves with a valid Interaction Manager in the scene (unless a special one has already been assigned in the inspector). There must be at least one Interaction Manager in each scene so that Interactors and Interactable Objects can communicate.

“XROrigin [3]”: In an Extended Reality (XR) environment, the XR Origin represents the central point of the virtual world. The primary purpose of the XR Origin is to accurately translate trackable features and objects into their correct scale, orientation, and position within the Unity scene. It provides specific information about a Camera, a Floor Offset Object, and an Origin to achieve this alignment.

7-New Tools and Technologies Used

7.1- Meta Quest 2

We used Meta Quest 2, one of the technological devices released in recent years, in our VR game project. This choice is due to the many key features and improvements that Meta Quest 2 offers. For example, Meta Quest 2 can operate wirelessly and provide mobility to the user. This feature is very important for our VR game as it allows users to move freely in real physical space. In addition, Quest 2 increases the user's efficiency in the game without restricting the user with a cable. In addition, the fact that Quest 2 is advanced in terms of optimization and compatibility is one of the reasons why we use this technology.

7.2-Unity 2022

We wanted to develop our game in Unity because the inclusion of Unity in our toolset offers various advantages that significantly increase the development and performance of our game. One of Unity's greatest strengths is cross-platform support. It allows us to develop our game for VR headsets like Oculus Quest 2, PCs and potentially a variety of platforms. This feature allows our game to reach a wider audience. Additionally, Unity's Asset Store is a valuable resource that provides access to a large library of assets, tools, and plugins. This resource was instrumental in improving the visual features of our game.

7.3 Hand Tracking

Another technology we use in our game is hand tracking technology. Thanks to Quest 2's left and right touches, we can observe this situation in the game when we move our hand. Thanks to hand tracking and touches, we can perform many of our mechanics. For example, we can perform our movements in the game thanks to the joysticks of the touches. Additionally, thanks to Hand Tracking, we can perform operations on the computer we will use in the game.

8-Test Cases and Results

Test case 1: Testing of gameplay mechanics.

In-game movement mechanics have been tested in this case. It has been observed whether these mechanics will challenge the user. Potential problems or bugs that may arise have been observed. It is aimed that the mechanics of the game will not be too challenging for the user and will appeal to the general audience. During the testing phase, this situation was carefully examined and the necessary feedback was received from the users. The test was completed successfully. As a result of the feedback received, minor changes were made and the mechanics were redesigned.

Test case 2: Testing the usage mechanics and interface of the computer in the game

In this case, the usage mechanics and interface of the computer in the game have been tested. It was observed whether the mechanics of the computer on which the player in the game would perform the tasks were working. In addition, in this case, it was observed whether the interface of this computer was difficult to use by the general public. Additionally, it was observed whether users were using this computer. The test was completed successfully. As a result of feedback received from users, improvements were made to the computer interface.

Test case 3: Testing performance and compatibility

In this case, optimization of game performance and compatibility between hardware and software configurations were tested. This test was carried out to ensure that users do not experience any performance problems while playing the game. Because the game contains performance problems, which affects the player's enjoyment of the game. As a team, we tested the elements that could cause problems during the testing phase and the situations that would affect the performance of the game so that users could get the maximum benefit from the game. For example, we tested whether the computer the player would use in the game responded to the player's commands without delay. As a result, the test was completed successfully. As a result of the tests, necessary adjustments were made to increase performance.

Looking at the general tests, care was taken to ensure that the mechanics of the game appeal to the general audience and can be easily applied by the general audience. Care was taken to ensure that the interface of the game was attractive to users. Additionally, it was observed whether the visual objects used in the game were tiring for the user. The performance of the game has been tested and the performance problems that users may experience while playing the game have been reviewed. Necessary changes were made in line with the feedback obtained as a result of the tests.

9-User Manual

9.1- Starting and Setup

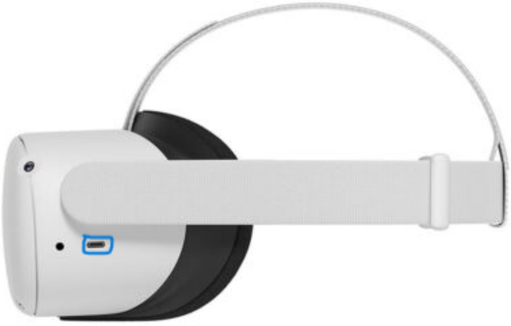


Figure 1: Meta Quest 2 Headset [4]

First of all, to connect the VR headset to the computer, the user must connect the computer with the Type-C output on the side of Meta Quest 2. You can see this type-c socket in Figure1.

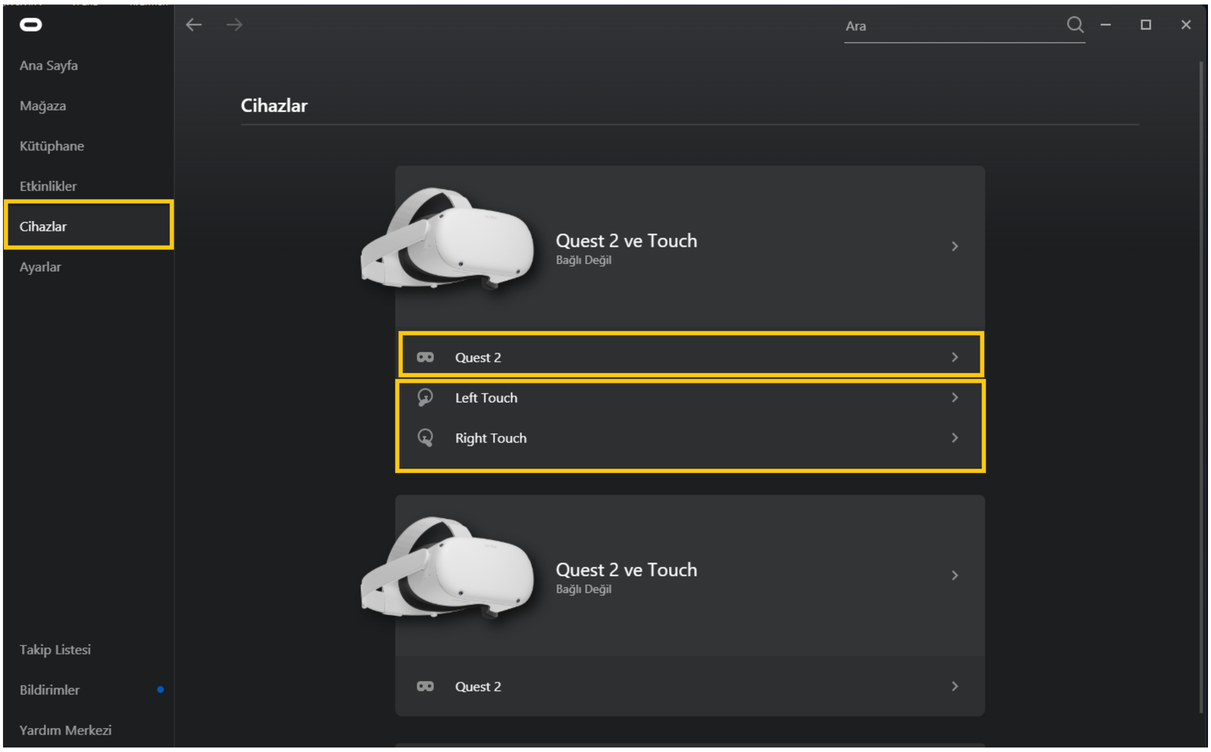


Figure 2: User interface of Oculus app, devices tab

Then, the user can check whether Quest2 is connected or not and the status of left and right touch from here. You can see these devices tab on Figure 2.

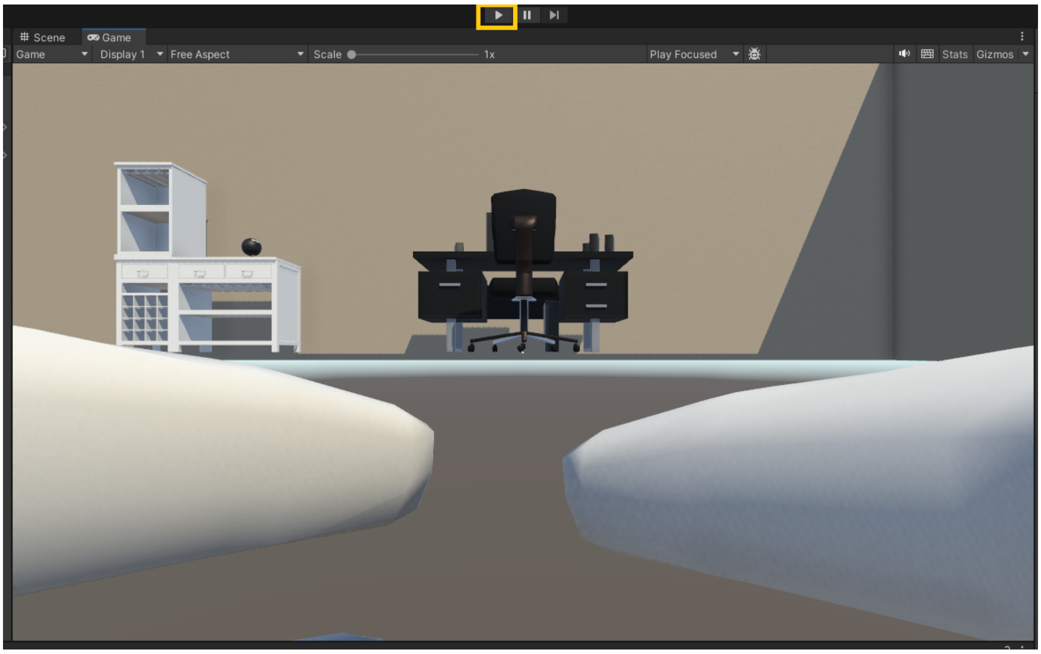


Figure 3: Play button to start a game.

To start the game, the user can open the game in unity application. As seen in Figure 3, the user can start the game from the button marked in yellow.

9.2 Gameplay and Mechanics

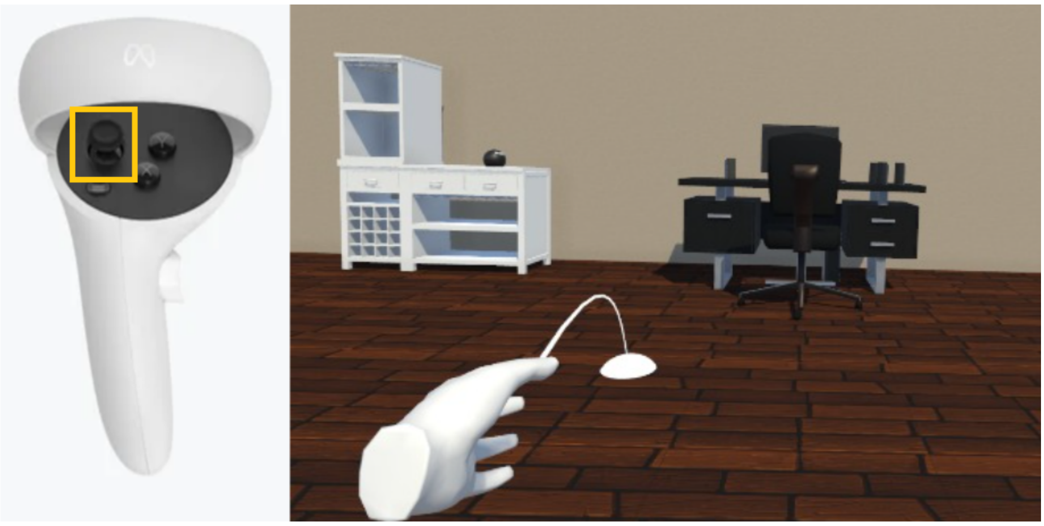


Figure 4: Demonstration of in-game movement and teleportation mechanics.

To teleport within the game and go to a certain point, the user performs the meta quest by using the left touch joystick. The player can select the point he wants to go to with left touch and teleport there. This is how in-game movement is achieved.

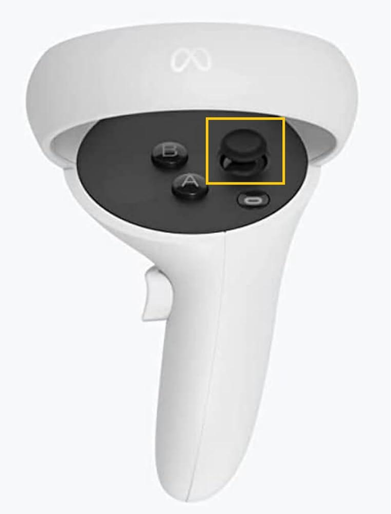


Figure 5: Enabling the character to turn left and right.

To enable the character to turn left and right, the user can use the joystick of the right touch. In this way, the user can perform right and left body turns without turning his head right or left, thanks to right touch.

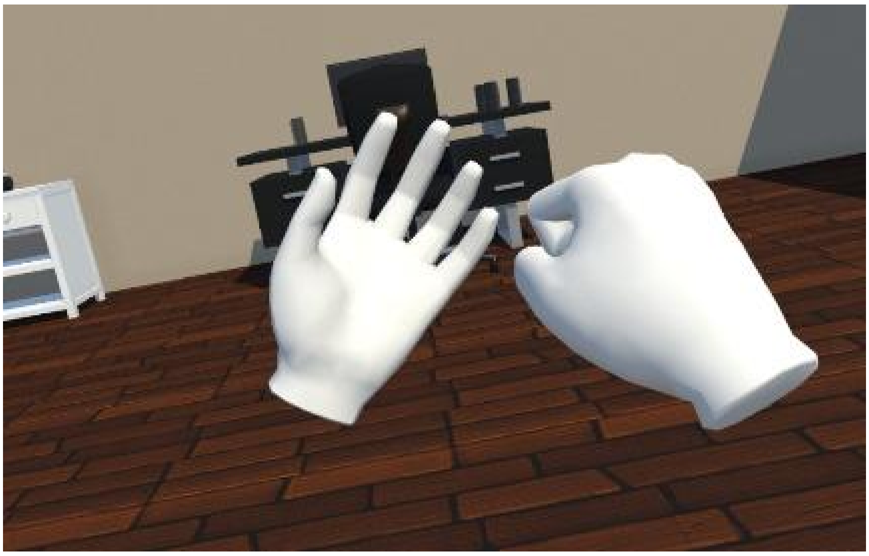
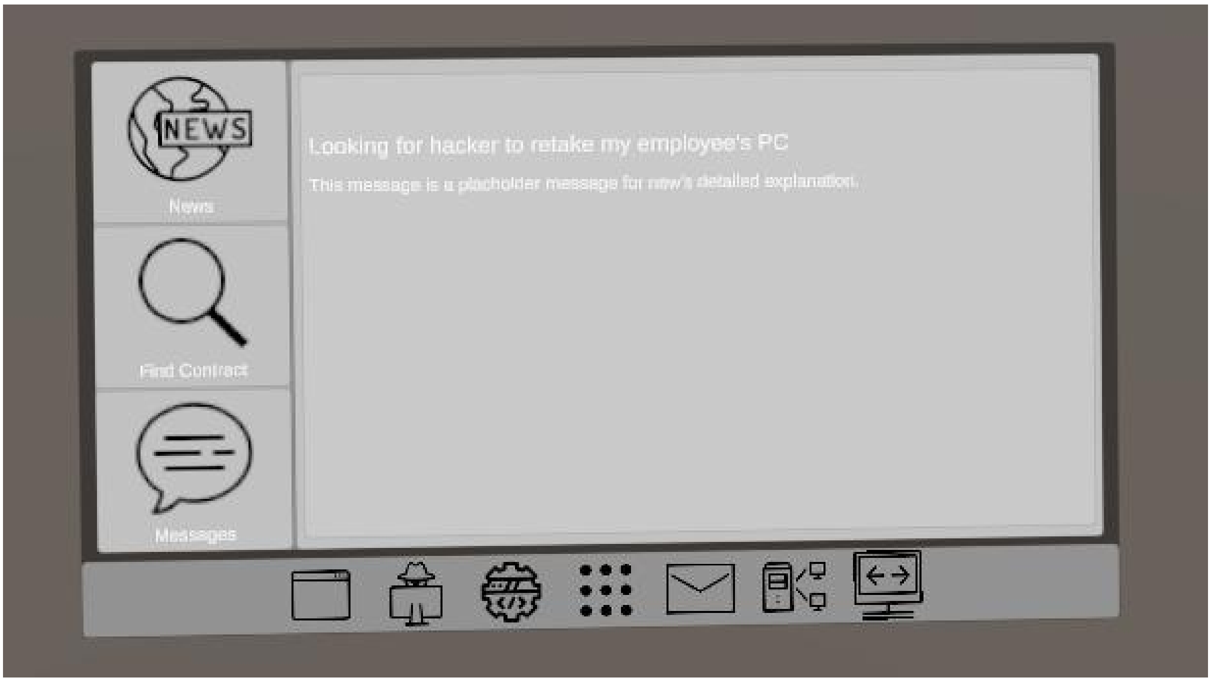


Figure 6: Control of the hand and holding objects in the game.

The user can perform these operations with the trigger key on the left and right touch to control the hand and hold the objects in the game. As can be seen in Figure 6, the user can move the hands of the character in the game thanks to these touches.

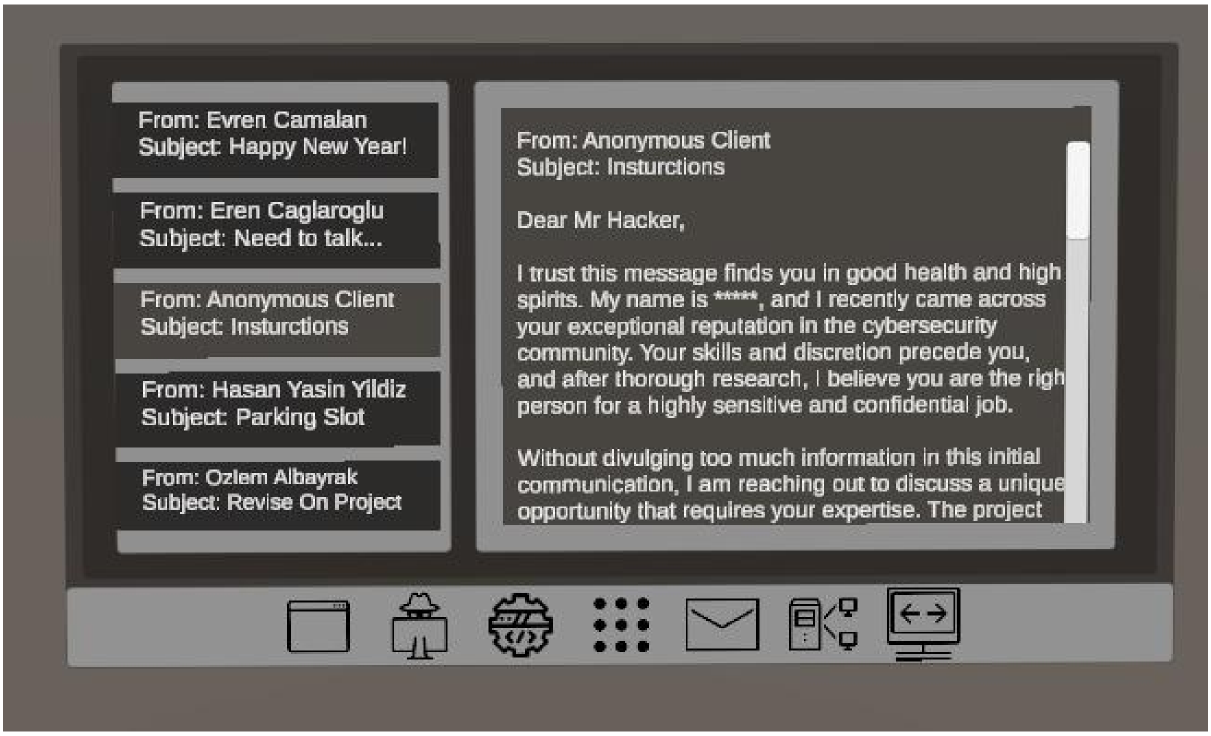


Looking for hacker to retake my employee's PC

This message is a placholder message for new's detailed explanation.

Figure 7: Turning on the computer the character uses.

To turn on the computer used by the character, the user must bring the touch pad in his right hand to the headset and press the trigger button. When the user presses the trigger button of the right touch, the PC screen opens as seen in figure 7.



From: Evren Camalan
Subject: Happy New Year!

From: Eren Caglaroglu
Subject: Need to talk...

From: Anonymous Client
Subject: Insturctions

From: Hasan Yasin Yildiz
Subject: Parking Slot

From: Ozlem Albayrak
Subject: Revise On Project

From: Anonymous Client
Subject: Insturctions

Dear Mr Hacker,

I trust this message finds you in good health and high spirits. My name is *****, and I recently came across your exceptional reputation in the cybersecurity community. Your skills and discretion precede you, and after thorough research, I believe you are the righ person for a highly sensitive and confidential job.

Without divulging too much information in this initial communication, I am reaching out to discuss a unique opportunity that requires your expertise. The project

Figure 8: Choosing applications on pc

To select applications on the PC, the user can select the desired application with the trigger button on the touch. As can be seen in Figure 8, the user has selected the mail application and displays the mail screen.

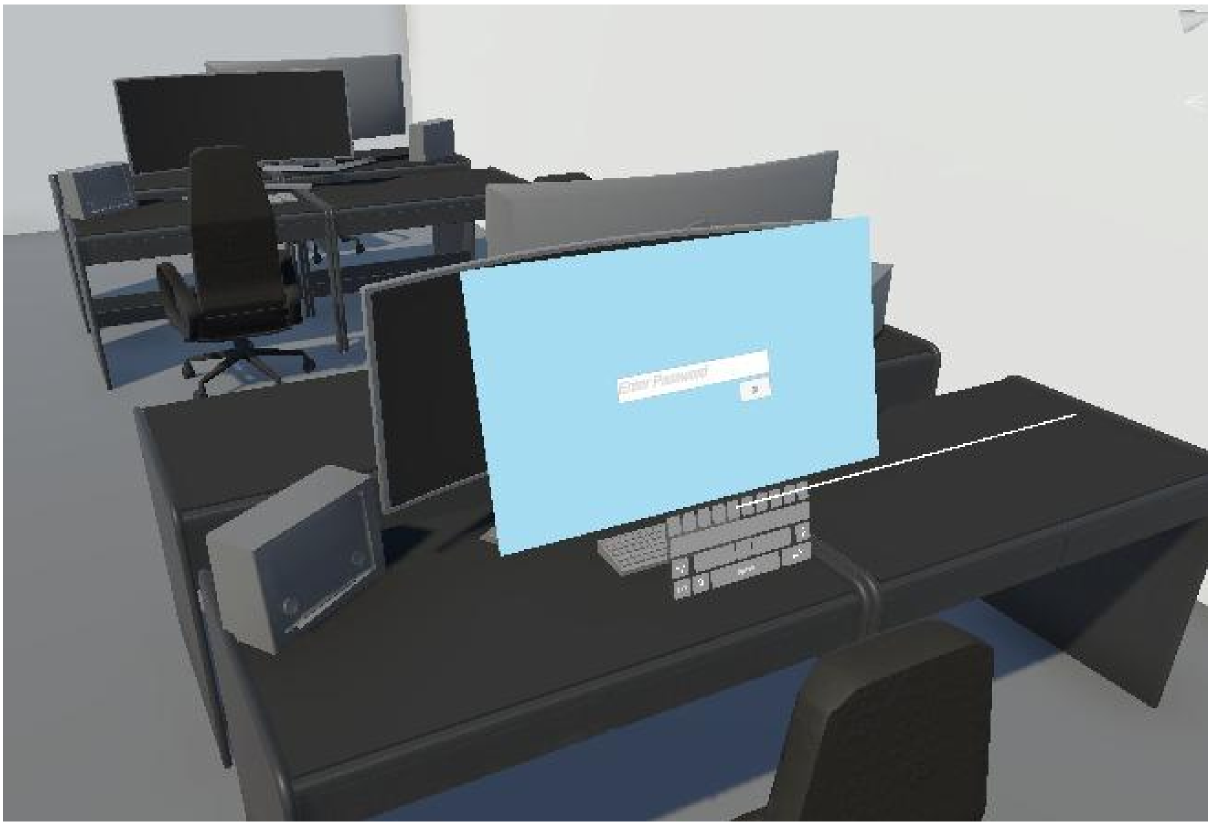


Figure 9: Office environment.

For the first task, the user will go to the office environment and perform the desired task there. As mentioned before, movement in the office environment is performed with left touch. The user will also be able to control the computer in this office environment with the trigger button of the touch.

10.References

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