Geometric
Image

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Problem Statement

Despite the high potential of Augmented Reality, technologies are having a hard time of   these breaking though into the public market.

To dive deeper into this subject I set a goal:

 To actively learn about Augmented Reality and Tello drone technologies. To understand how they can be integrated and become more useful, accessible and exciting for the public. All this by attempting to create an instance of such a publicly

Project Scope

▶ **<u>Background</u> –** There are lots of AR technologies, from simple face filter apps to intricate headsets such as Holo Lense. Some of them succeed in penetrating our daily lives for a while but almost none of them get fully integrated.

▶ **<u>Goal</u> -** To actively learn about AR and Tello drones to understand the challenges and capabilities of these technologies and better understand how they can be integrated and become more useful, accessible and exciting for the public.

▶ **<u>Method</u>** – To integrate AR technologies with Tello drones in a format of a first-person shooting game.

▶ **<u>Hypothesis</u>** – The main problems might be high cost, bugs, lack of useful ideas, user-unfriendly I/F, or time for the public to get use to something new.

Project Objectives

Main Objective:

> **To integrate AR technologies with Tello drones in a format of a first-person shooting game.**

Sub-Objectives:

1. To understand how to render virtual objects and anchor them in real space.

2. To add functionality to the virtual objects for intractability.

3. To create a simple, visually appealing user interface.

4. To add appealing visual and audio effects for a more. exciting user experience.

5. Deploy the software as an application for Android phones.

Milestones and Challenges:

1. **Starting with python** – This was the most appealing choice due to my familiarity with python, the simplicity of the language and vast supply of useful libraries such as opencv and Tello packages.

2. **Trying to render VR objects in python –** When trying to tackle the calibration & localization problem, it became clear to me that python is not sufficient for this job, and I began to look for other options.

3. **Switching to Unity** – Even though I wasn't familiar with Unity or C# the demonstrations of Unity's amazing capabilities quickly persuaded me to switch to this platform.

4. **Finding Vuforia –** Now the downside was that I didn't have opencv and had to find a solution for calibration and localization in order to anchor the virtual objects in space. Luckily after an intense research I found Vuforia - amazing software based on clever computer vision algorithms. Vuforia offered a vast SDK for solving exactly these type of problems.

5. **Target Images** – The solution I first chosen from Vuforia's SDK was "target images". This SOLUTION required to create a database on Vuforia's site with images chosen beforehand which later could be used in Unity in order to render virtual objects above them.

6. **Adding Virtual Objects** – At this stage I found the Asset Store extremely important. I downloaded free visual assets and adjusted them for my specific needs.

7. **Adding Functionality** – At this point I began to write scripts in order create a sense of intractability. Scripts for shooting, movement, collecting bonus objects etc.

7. **Mid Presentation** – The presentation took place on 9.1.19. At this point I presented the ability to control the Tello drone from Unity. As well as the rendering of a virtual Target above a book, which reacts when hitting it with virtual lasers after hitting the right mouse button.

9. **Switching to UDT** – When the game started to take shape, I began to think more about the UX, and realized that it would be very inconvenient for the user to obtain the exact images I have chosen as target images. And so I switched to a different method from Vuforia's SDK - The User Define Target images. This solution allows the user to define in run time their own target images for rendering virtual objects. However this solution was not easy to work with and required lots of changes in order to create a simple, usable UI.

10. **Adding special effects** – Again I used the asset store for the visual and sound effects. A lot of time went into choosing the exactly right effects and interlacing them in the scripts.

11. **Creating the UI** – Unity has a simple interface for creating a UI without the need for too much coding. My main approach was to activate and deactivate relevant panels on the press of the buttons. Creating the options menu was much more difficult.

12. **Creating the app** – Switch between platforms is very simple in Unity. However it required a few adjustments to the UI format.

13. **Final touches** – After receiving feedback from family and friends, I began to fix small bugs, organizing the code and improving the user experience. As well as adding instructions, messages and explanations in various stages of the game.

14. **Final Presentation** – The final presentation took place on the 27.5 Due to COVID19 I couldn't obtain the wireless camera needed to integrate the game with the Tello drone and presented the project on the computer with and external camera via Zoom.

Results

▶ The result is a fun user-friendly AR first-person shooting game for Android. The game is divided into 3 main stages: configuring the target images, the main menu, the gameplay.
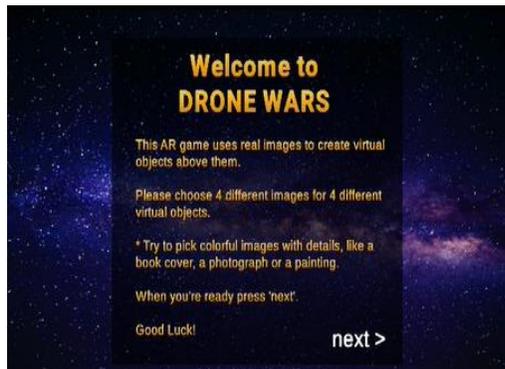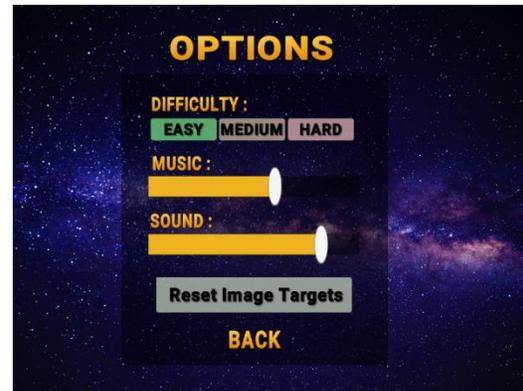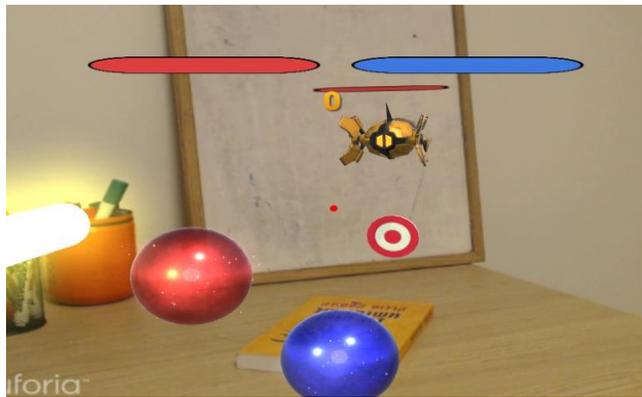
What I learned

▶ I learned how to create a fun AR user-friendly FPS game for Android in Unity.

▶ From the feedback I received I learned that even though I did my best in creating a user-friendly interface the game was still confusing to some people (especially the image configuration stage).

▶ Also I understood that this game as it is now, is fun to play once or twice as a demonstration of the cool futuristic AR capabilities but other than that it is not useful or addicting.

▶ After encountering different challenges I learned that AR technologies have lots of room for improvement before they can become mainstream. The technology will have to improve mainly by enhancing calibration and localization methods by using innovative computer vision techniques and additional external sensors.

▶ I saw that all project stands on the shoulders of giants. I was able to progress and finish this project mainly thanks to the knowledge of experienced developers as well as their ready-made assets. Two of these giants are Unity and Vuforia, others are mentioned in the bibliography.

▶ Unity is an amazing, easy to use platform for a variety of projects. It is a great tool for creating relatively low-cost AR applications with a simple UI and a fun UX

▶ Vuforia technologies are one of the leading software technologies in computer vision and Augmented Reality.

Future Work

The next steps for this projects can be:

1. Adjusting this game for Tello drones by attaching a small wireless HD camera to the drone and adding Tello control package.
2. Adding a multiplayer option for multiple drones/phones with a wireless connection. And the ability to shoot each other.
3. Adding more levels and interactable VR objects.
4. Replacing Vuforia UDT with SLAM for better localization and rendering.
5. Adding AI capabilities to the enemy drone.
6. Deploying the game for iOS, windows and Holo Lense.

Bibliography and Utilities

- Tello Utility Package:
  https://github.com/comoc/TelloForUnity by Akihiro Komori

Unity Asset Store Utilities:

- Absolute Space & Sci-Fi Music by Voltz Supreme
- Free Sound Effects Pack by Olivier Girardot
- Grenade Sound FX by MGWSoundDesign
- Inferno VFX by Mirza Beig
- Low poly combat drone by VoodooPlay
- Magic Particle Systems Lite by Goldman Studio
- Procedural fire by HOVL Studio
- Ultra Sci-Fi Game Audio Weap. By Eric Berzins
- Volumetric Lines by Johannes Unterguggenberger

Youtube:

- **Brackeys channel –**
  https://www.youtube.com/channel/UCYbK_tjZ2OrIZFBvU6CCMiA
- **Jason Weimann channel–**
  https://www.youtube.com/channel/UCX_b3NNQN5bzExm-22-NVVg
- https://www.youtube.com/watch?v=C8A48bpdwOU
- https://www.youtube.com/watch?v=zc8ac_qUXQY&t=310s

Website:

- https://answers.unity.com/
- https://developer.vuforia.com/forum
- https://stackoverflow.com/