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UI 设计基础

# Introduction to UI Design Course

REPORT ON

**Augmented Reality Implementation Using Vuforia: Image  
and Multi Target Techniques**

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2024 年 11 月 27 日

## Abstract

This report discusses the implementation of augmented reality (AR) applications using Vuforia in Unity. Two AR setups were developed: one using an Image Target and another utilizing a Multi Target. The report provides an overview of the principles of AR, the steps involved in creating the applications, and their potential applications in various industries. Screenshots of the implemented AR applications are included to illustrate the results.

## 1. Introduction

### 1.1 Background

Augmented reality (AR) integrates digital elements into the physical world, enhancing user experiences by overlaying virtual content in real-time. AR has applications across multiple domains, including education, entertainment, retail, and healthcare.

### 1.2 Objective

The objective of this project is to implement and demonstrate AR applications using Vuforia, focusing on two types of targets:

- **Image Target:** Recognizing and displaying 3D models on a flat image.
- **Multi Target:** Mapping virtual 3D models to multi-surfaced physical objects, such as a cube.

### 1.3 Scope

This project illustrates the development of two distinct AR solutions and provides insights into their technical implementation. This report also discusses the principles of AR and the potential applications of these technologies.

## 2. Principles of Augmented Reality

Augmented reality functions by combining computer vision, machine learning, and spatial mapping technologies. Key components include:

- **AR Camera:** Captures real-world images and serves as a viewport.
- **Image Recognition:** Identifies predefined targets using feature-based algorithms.
- **Virtual Content Overlay:** Displays 3D models, videos, or animations on recognized targets in real-time.

## 3. Methodology

### 3.1 Tools and Technologies

- **Vuforia Engine:** An AR SDK integrated with Unity for target recognition and tracking.
- **Unity Editor:** A real-time development platform for creating and visualizing 3D models.
- **Hardware:** A computer and a smartphone for testing the AR applications.

## 3.2 Workflow

1. **Setting Up Vuforia in Unity:**
  - Download and install the Vuforia Engine from the Unity Asset Store.
  - Configure the AR camera and add a Vuforia license key.
2. **Creating AR Applications:**
  - **Image Target:**
    - Import an image into the Vuforia Target Manager and generate a dataset.
    - Add the Image Target prefab in Unity and link it to the dataset.
    - Attach a 3D model to the Image Target for display upon recognition.
  - **Multi Target:**
    - Design a cube or multi-sided object as the target.
    - Upload images for each side of the cube in the Vuforia Target Manager.
    - Configure Unity to map a 3D model onto the multi-sided object.
3. **Testing the Applications:**
  - Deploy the project on a smartphone and verify the AR experience.

## 4. Implementation

### 4.1 Image Target

For the Image Target setup:

- A 3D zombie cartoon model was used (as shown in **Figure 1**).
- The system detects a flat image (a card) and renders the model on its surface.
- This implementation highlights how 2D targets can trigger AR experiences.

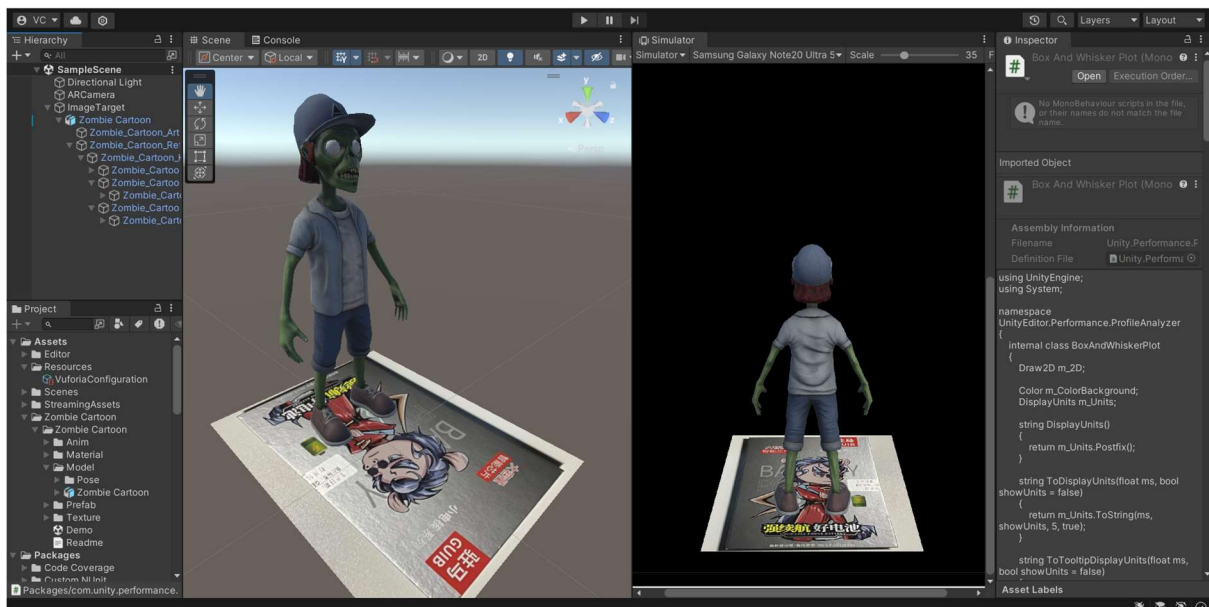


Figure 1: Zombie cartoon rendered on an Image Target.

## 4.2 Multi Target

For the Multi Target setup:

- A cube with anime-themed textures was utilized as the physical target.
- A 3D soldier model was mapped to the cube, demonstrating multi-surface tracking (as shown in **Figure 2**).
- This implementation showcases AR for complex physical objects.

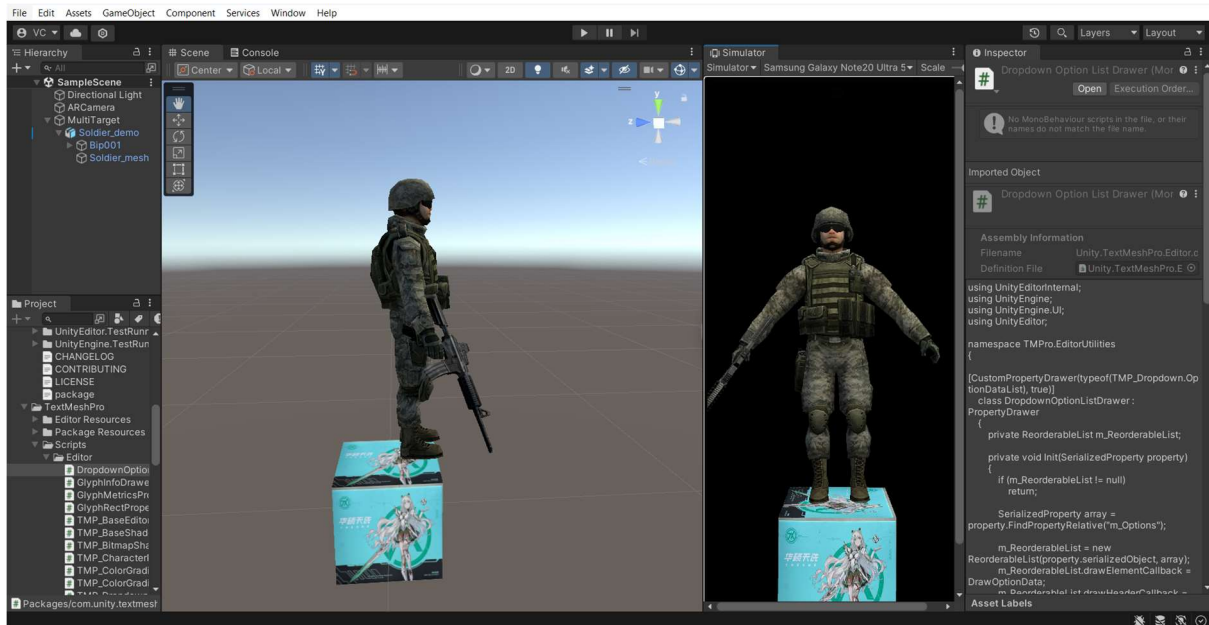


Figure 2: Soldier model mapped to a cube using Multi Target.

## 5. Results

The AR applications successfully achieved the intended functionality:

- **Image Target:** The system accurately tracked the flat image and rendered the 3D model with precision.
- **Multi Target:** The 3D model aligned correctly with the cube's surfaces, demonstrating reliable multi-surface tracking.

These results validate the effectiveness of Vuforia's tracking capabilities and Unity's integration for AR applications.

## 6. Discussion

### 6.1 Challenges

- Calibration of target images required precise scaling and alignment.
- Testing on different devices showed variations in tracking stability due to environmental lighting.

## 6.2 Future Scope

These AR implementations can be extended to:

- **Education:** Interactive learning experiences.
- **Retail:** Visualizing products in real-world environments.
- **Gaming:** Creating immersive game setups using multi-surface targets.

## 7. Conclusion

This project successfully implemented two AR applications using Vuforia. The Image Target and Multi Target approaches demonstrated the versatility and practicality of AR in enhancing user experiences. The insights gained from this project pave the way for further exploration into advanced AR applications.

## References

1. Unity Technologies. *Unity Documentation*. Retrieved from <https://unity.com>
2. Asset Store: <https://assetstore.unity.com/>
3. PTC Inc. *Vuforia Developer Library*. Retrieved from <https://developer.vuforia.com>