

# Application Development with Augmented Reality Technique using Unity 3D and Vuforia

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## Abstract

The application of Augmented Reality (AR) based on mobile terminals is a hot topic of interests for mobile applications and human-machine interaction. Mobile AR technique combines the intelligent display, registration tracking, virtual and reality convergence, and human-computer interactions through portable devices or intelligent terminals. This allows the 3D virtual object to be fully docked with the customer's actual scene, thus increasing the perceived range[1]. This study uses Unity 3D modeling to create a three-dimensional model of the scene and to detect and track the totem functions of the Vuforia engine. It can set animation and play video. Interactions between virtual buttons and virtual reality can also be created as virtual buttons. The AR application in the Vuforia SDK is a hub that connects the virtual world with reality. The monitor of the mobile terminal merges the actual video and the virtual object, enabling three-dimensional tracking and registration. This article shows you how to design your game and apply AR technology in a Unity 3D environment.

**Keywords:** Augmented Reality, Image Recognition, Unity 3D, Vuforia, 3D registration

## INTRODUCTION

AR is a new technology evolving from virtual reality. This method mainly enhances the user's perception of the real world based on the information offered by computer system and reality can be "augmented" by means of overlaying the computer-generated virtual objects, scenarios and system prompts to the real scene. It primarily assists human beings in displaying the unreachable scenes in the real world[2].

Vuforia AR Software Development Kit(Vuforia AR SDK) is designed by Qualcomm for AR applications of mobile devices. It identifies and captures planar images or simple three-dimensional objects(such as boxes) timely by means of computer vision technology. Then it permits developers placing virtual objects through camera viewfinder and adjusting its position in front of the lens[3].

AR is a technology that seamlessly integrates real-world and virtual information. The physical information(visual information, sound, taste, smell, etc.) that is not easy to

experience in the real world in a certain time and space is simulated and superimposed by using computing technology. Virtual information is applied to the real world and perceived by human beings. So the experience surpassing the reality is achieved. Real environment and virtual objects are superimposed on the same screen or space in real time[4].

AR contains various technology multimedia, 3D modeling, real-time video display and management, fusion of multiple sensors, real-time tracking and registration, scene combination and other new technologies and new tools. AR provides information that is disparate from human perception in half of the cases[2].

This paper researches the application of Unity 3D -the integrated game development tool of multiple platform. It employs the mobile device augmentation of the real application software development kit developed by Qualcomm. People can experience AR which is also known as the hybrid reality in the Unity 3D environment. The application of AR technology in Unity 3D can be reflected through the design of a game and the basic use of enhancing the reality can be researched.

## Basic Applications of Unity 3D & Vuforia in AR

The typical AR application is principally composed of off-line and on-line processing. The off-line processing covers the selection and treatment of identification objects in advance, geometric model of objects in the virtual world, establishment of physical model, generation of behavior model and three-dimensional scene. This part is mainly completed by Unity 3D. The on-line one also includes identification of objects, and produces the corresponding feedback information in real time and real scene. The virtual object is added to reality and the human-computer interaction is realized[5]. This process is mainly performed by Vuforia SDK.

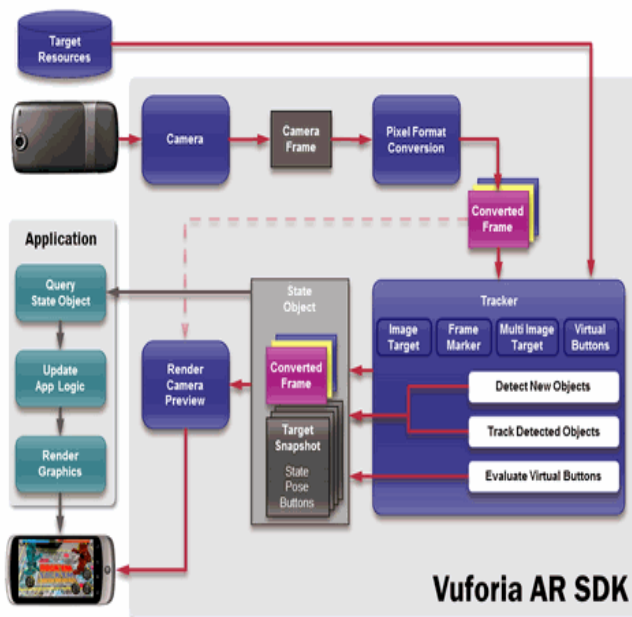
## Unity 3D

Unity 3D is a cross-platform integrated 3D game engine developed by Unity Technologies Co.Ltd. It can superpose the virtual onto reality and realizes human-computer interaction with some AR development tools. It allows Vuforia SDK

extension plug-ins to detect and track under the corresponding ports and creates AR applications and games. It provides ample development box functions to create games and other interactive 3D content[8]. Unity 3D can append sunlight, fog, wind, sky box, water and other physical materials, ambient sound and animated video to the virtual scene. Meanwhile, you can browse, test and edit 3D application scenarios. Also it is available to release to the required platforms, such as Windows, iOS, Android and so on.

**Vuforia SDK**

Vuforia SDK is an AR software development kit for mobile devices launched by Qualcomm. It utilizes computer vision technology to recognize and capture planar images or 3D objects in real time and permits developers placing virtual objects through the viewfinder of the camera and adjusting the position of objects on the background of the camera. Vuforia SDK supports types of 2D and 3D objects including multiple target configurations, images with fewer symbol and frame tags. There is an added function in the SDK. It takes advantage of virtual buttons to detect localized occlusion. Moreover it can select and reconfigure the target image in real time and create a target set according to the scheme. The data flow diagram of the Vuforia SDK is shown in figure 1[6].



**Figure 1.** Data flow diagram of Vuforia SDK

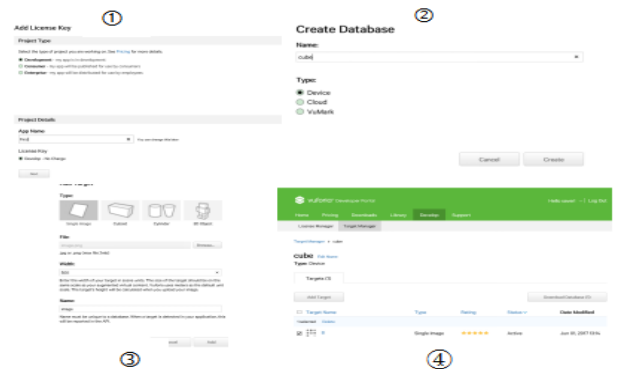
The data stream of Vuforia SDK is divided into four modules: inputting, database, tracking and matching and render output.

Mobile phones can seize images of each frame in the present real scene through the camera and then matches identification objects in the database timely according to the pixel format conversion. After that, it adds preset virtual objects such as 3D model, animation or video to real scenes. It can also interact with these virtual objects, render and output information at mobile terminals[6].

**Environment Development and Production Process of AR Tower Defense Game**

**A. Establish of the Environment**

- ( 1 ) Download development resource Unity 3D 5.5.0 and then install
- ( 2 ) Download the Vuforia QCAR development plug-ins.
- ( 3 ) Create the identification object on Vuforia net.
  1. Create license: Click Develop on the development home page of Qualcomm Vuforia and then Add License Key on License Manager. Select Development and name the App First. The object is generated.
  2. Create Database: Click Add Database on Target Manager and namecube. Thus the creation is completed.
  3. Create Target: select the cube that has just been created. Establish the identification target. Elect Single Image and the picture path. Set the picture width and complete the creation.
  4. As shown in figure 2, download and create a good identification target.



**Figure 2.** Creation of Identification Object on Vuforia.

**B. Process of AR Tower Defense Game Generation**

- ( 1 ) Create a new engineering project in Unity.
- ( 2 ) Download the Vuforia - Unity - 6 - 2 - 10, Unity package plug-ins on Vuforia.
- ( 3 ) Import the Vuforia plug-ins in Unity and the downloaded Unity package file
- ( 4 ) After importing, Plugins folder and Vuforia appear will appear under the Asset directory. Delete the Main Camera in Hierarchy and then drag the AR Camera and Image Target under the Vuforia /Prefabs directory to the scene.
- ( 5 ) Select AR Camera in Hierarchy to view the Inspector window. Click Open Vuforia Configuration in Inspector window and fill in the App License Key.

Enter the Vuforia website. Locate the established License Key. Copy it to Unity and alter other parameter settings.

- (6) Select the Image Target in Hierarchy to view the inspector window. Click database in Image Target Behavior and choose the Unity package file just imported. Click Image Target again and elect the target image contained in the import file.
- (7) Add the required 3D model to Hierarchy. Drag the model into the Image Target and become an auxiliary object of the Image Target. Change the parameter settings related to each model.
- (8) Add UI settings to Hierarchy then select it. Click the Canvas and create it. Create a subsidiary object in the canvas to get command of the disparate display in the game including enemy killed points and scores displayed, player's hit points, equipment options (laser weapons and bullets, respectively), bullet buttons and so on.
- (9) Create the script Game Manager and UI Manager functions. They have several roles including UI display, weapon switching, monster generation waves and numbers, monster generation interval, laser damage and so on. Monster in tower defense game usually arises in batches. For they are numerous, a monster generator is essential to produce diverse monsters in the order set in advance.
- (10) Create a script Ctrl\_Bullet function in the Bullet under the Canvas and set the player's bullet damage.
- (11) Create the Enemy Ctrl function in the warrior, set attack and monster movement speed, monster damage and attack interval as illustrated in figure 3.

### Game Generation

This paper develops an AR tower game adding the virtual object to the real scene. When the camera lens position varied from the former one, the relative position and angle between the camera and the real scene also transform accordingly. Since the matching images are tracked, the application can accurately apperceive these changes and react correspondingly[7].

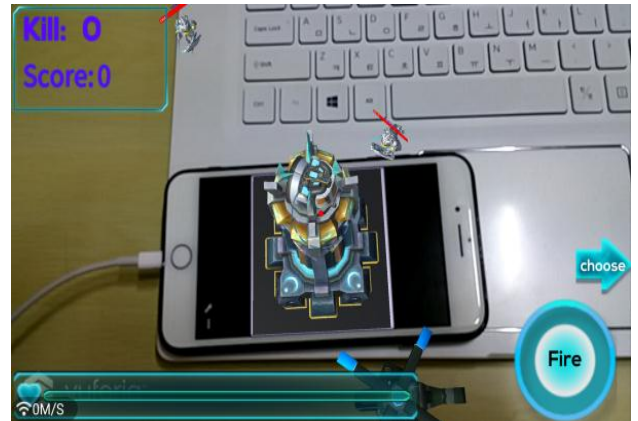


Figure 4. Game Generating Version

The virtual objects superposed onto the real scene will also alter in line with changes of position and angle of the camera. If the matching image disappears from the camera lens, the virtual object will vanish, as shown in figure 4[8].

### CONCLUSION

This paper emphasizes the Unity 3D technology and Qualcomm QCAR development tool, Vuforia and then introduces the basic concepts and framework. Based on this, the three-dimensional model of scene is simulated by the means of Unity 3D. The Vuforia engine can detect and track identification features and fabricate corresponding 3D model in accordance with the relative position and attitude information of sundry identifiers on the visual plane, the corresponding 3D model[9]. It can set animation, play video and interact the virtual and reality via virtual button mode. Furthermore, the whole process of the game environment can be displayed. Images fused after multi-angle observations make the experimental effect more vivid and almost real. The real-time synchronization satisfies the users in the real world to feel the virtual space, thus strengthening the spice and interaction.

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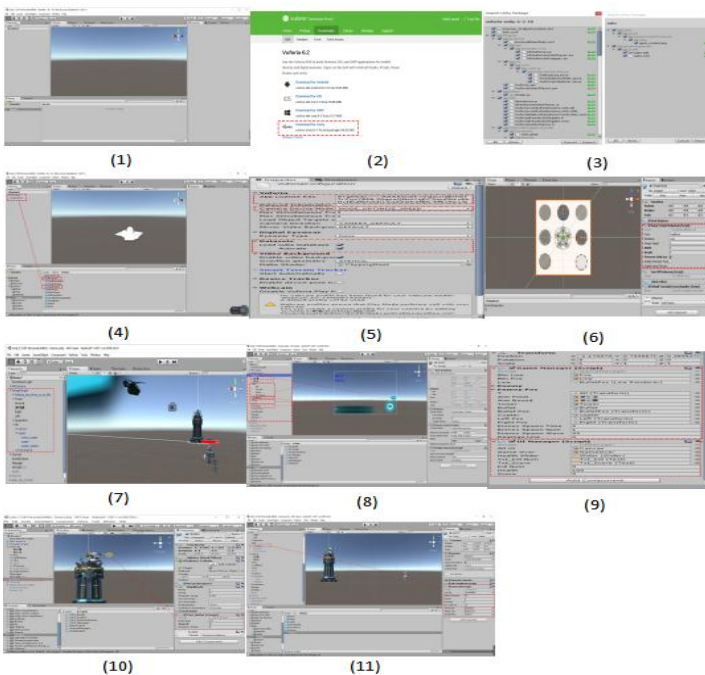


Figure 3. Fabrication Process of AR Tower Defense Game

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