# Interactive Augmented Reality Game Application

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BY

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**Date: 15/09/2016**

# Abstract

In this project, development of an Augmented Reality application was requested, analysis on which nowadays library should be used will be performed alongside the process of which game engine will the development be on.

The focus on producing a cards game for mobile phones using Unity3D game engine and Vuforia's augmented reality development kit will be the goal.

# Acknowledgment

# Table Of Contents

# *Chapter 1*

## Introduction

## 1.1 Background

Augmented Reality is the integration of digital information such as computer generated data such as graphics and GPS data with the user's environment in real time. Augmented Reality is different from Virtual Reality, which creates an artificial simulated environment. Augmented Reality applies digital information on top of the existing real life environment.

The term, Augmented Reality was invented by Boeing researcher from Boeing Computer Services in Seattle, Professor Thomas Caudell in 1990, Currently, AR application such as Google Glass and mobile games such as Pokemon Go are perhaps the most well-known consumer AR products. Augmented Reality (AR) has been associated with movies set, campaigns in a distant future, or situations that just seem gimmicky for the most part.

Making a game was never an easy task because the ultimate goal is to amuse people, but, building a video game with all graphics and controllers has raised the bar a little higher.
The creation of a game that interacts with player's environment takes our imagination a little further towards the future of entertaining, of course it comes with development, production and risks cost, but emerging our reality with a different (fiction) one is what we dream of, and the answer lies in Augmented Reality applications.

## 1.1 Objective

Building an AR game that concludes my own game design, concept and development.

## 1.2 Scope

Draw a production pipeline to make the application development cycle versatile and produce a unique yet fun to play game.

# *Chapter 2*
## Background Study

### 2.1 Literature Review

At the moment it's very comprehensive to grasp all the bits and pieces to develop an application in that framework, nevertheless, some of the open source libraries have made this computer vision and imagery process easier for application development.

The Augmented Reality libraries i have done comparison on have all been tested to find the most suitable one for the future development of the application, but, before the comparison, a few terms must be clear.

### What is open source library?

Is computer software with its source code made available with a liscense in which the copyright holder provides the rights to study, change, and distribute the software to anyone and for any purpose.

### What are markers?

**AR Markers** are a type of 2-dimensional barcode, most probably in a perfect black & white.square.

### What is NFT?

Short for Natural Feature Tracking where the markers are not in black & white only and the camera needs to be trained to track these images so, it is used for images that are not easy to built as bordered markers.

### What is camera training?

It's the process of training the camera on several images or just one image with specified details to improve tracking results.

| Comparison Point / AR Dev Kit | ARToolkit | IN2AR | Vuforia |
|---|---|---|---|
| Ease Of Use | ✓ | ✓ | ✓ |
| Supported Platforms | 🍎 ⊞ 📱 | 🍎 ⊞ 📱 | iOS ⊞ 📱 |
| In The Industry Since | 1999 | UKNOWN | 2011 |
| Reputation | Very high, most widely used AR library | Normal | High & growing bigger |
| Open Source | ✓ | ✗ | ✗ |
| Creation Of Markers | Unlimited | Limited To Liscense | Limited To Liscense |
| Camera Training Feature | Limited To PC's | Limited | Yes |
| Documentation | ✓ | ✗ | ✓ |
| Game Engines Support | Unity, Unreal | Unity | Unity |

Figure 1 (AR SDK Comparison Table)

## 2.2 Vuforia It Is!

As shown in  figure above the wisest choice to start developing an AR application is to pick-up ARToolkit but, overtime problems started to occur using the library with mobile phones as they provide limited access to some of the features such as camera training which is needed for a better user experience during the game.

so , as i am testing the other two libraries after i hit a wall with ARToolkit i found that IN2AR library is good for development only if it wasn't commented on in japanese !!, not to mention it was completely written in Flash and C# for Unity3D.

In the end, the testing lead me to choose Vuforia not because it's the last choice but because it's a very stable and feature-full AR SDK, even though the generation and storing of the markers is done online and the free license provides up to 100 markers maximum, it is great choice for the moment.

## 2.3 Game Engines With Vuforia
After choosing Vuforia as main AR SDK for the application it'll be wise to start developing the game with the library supported game engine which is Unity3D.



Figure 2 (Official Unity Logo)

### What is Unity3D?
You can create any 2D or 3D game with Unity. You can make it with ease, you can make it highly-optimized and beautiful, and you can deploy it with a click to more platforms than you have fingers and toes. What's more, you can use Unity's integrated services to speed up your development process, optimize your game, connect with an audience, and achieve success.
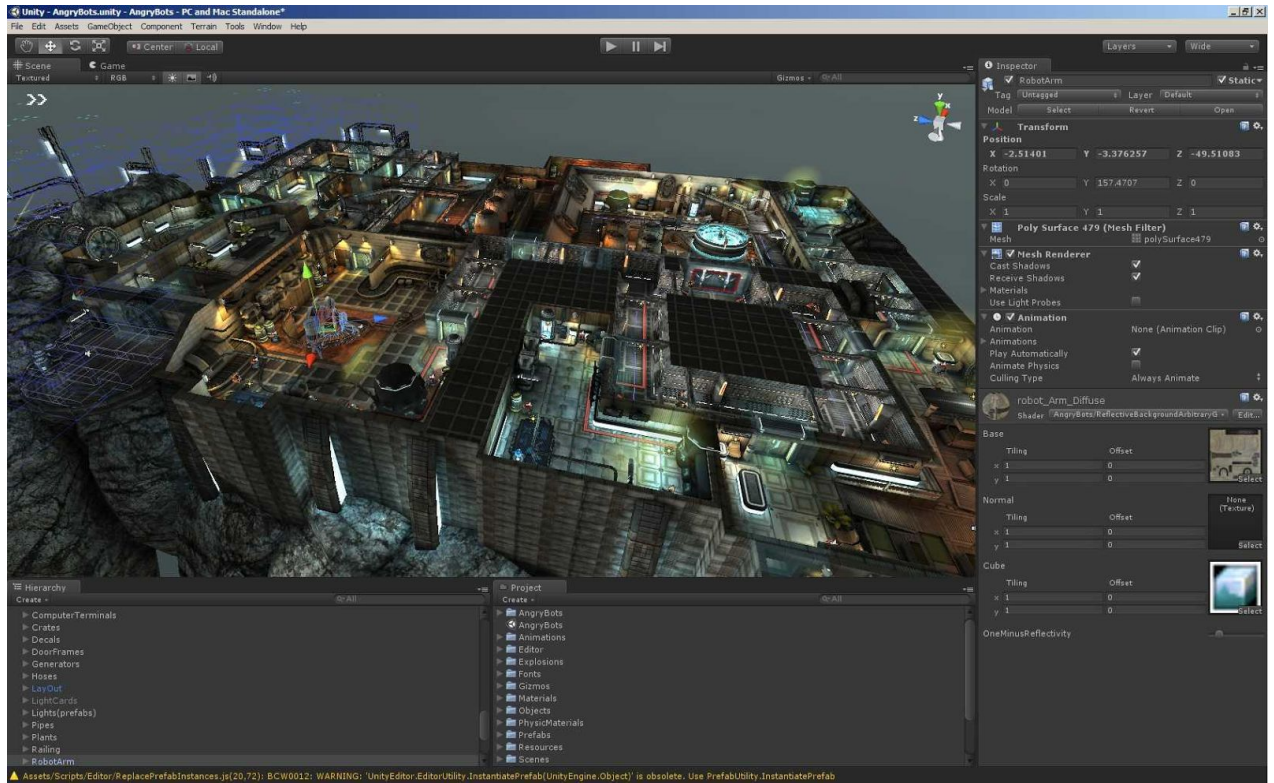
Figure 3 (Unity3D IDE)

Unity uses C# & Javascript as its main programming language but, in process of building this project i'll be using C# as the programming language and the targeted platform will be mobile devices.

# *Chapter 3*

## Requirements
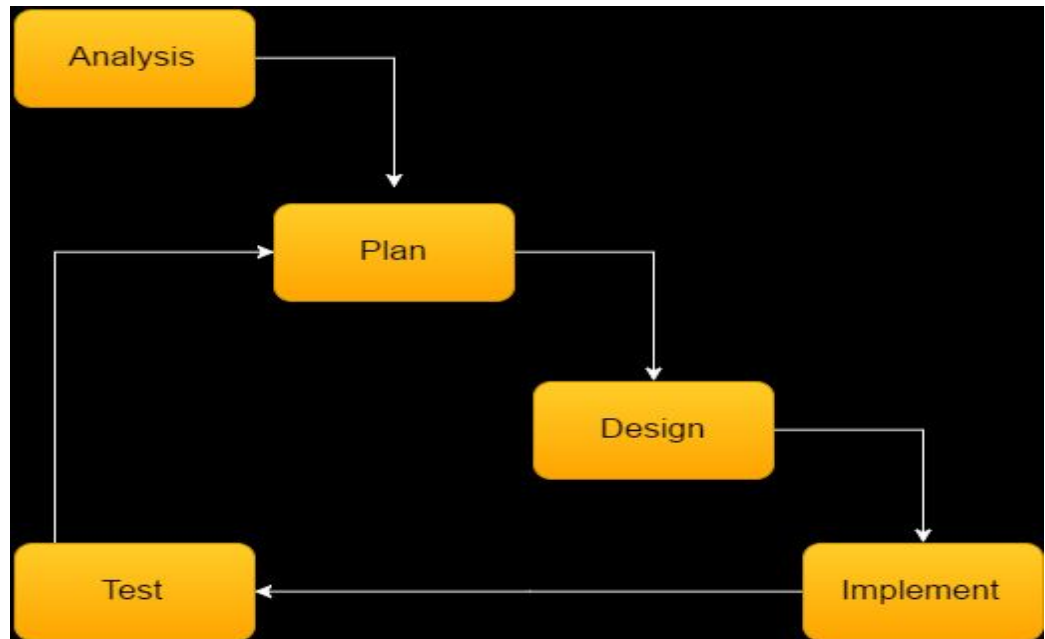


Figure 4 (System Requirement)

### 3.1 Analysis

Using a machine that is fully capable of rendering high-end graphics and work without lagging or possible loss of data is important, not to mention it has to be able to work side to side with the Vuforia SDK.

Recommended development machine specs:

- Windows .
- Intel Core i5 2.4GHz.
- nVidia Graphics Card.

### 3.2 Plan

To ensure users of the application get the most out of it, a minimum specs scope have to be set.

Targeted device minimum specs

- Android.
- Kitkat 4.6 (API 19).
- Quad Core chip-set processor.
- Rear Camera 10MP

# *Chapter 4*
## Design

### 4.1 Games with AR

Majority of the games in this field requires interaction with the environment of the player with or without some predefined images [markers], GPS locations and/or sounds, so making games in that sense has to be a little bit over creative standards.

An example of one of the technology sensation nowadays is Pokemon Go, where the concept of augmentation is performed at its finest, with nothing much but the GPS location of the player and the phone's camera they managed to get players out of their caves.

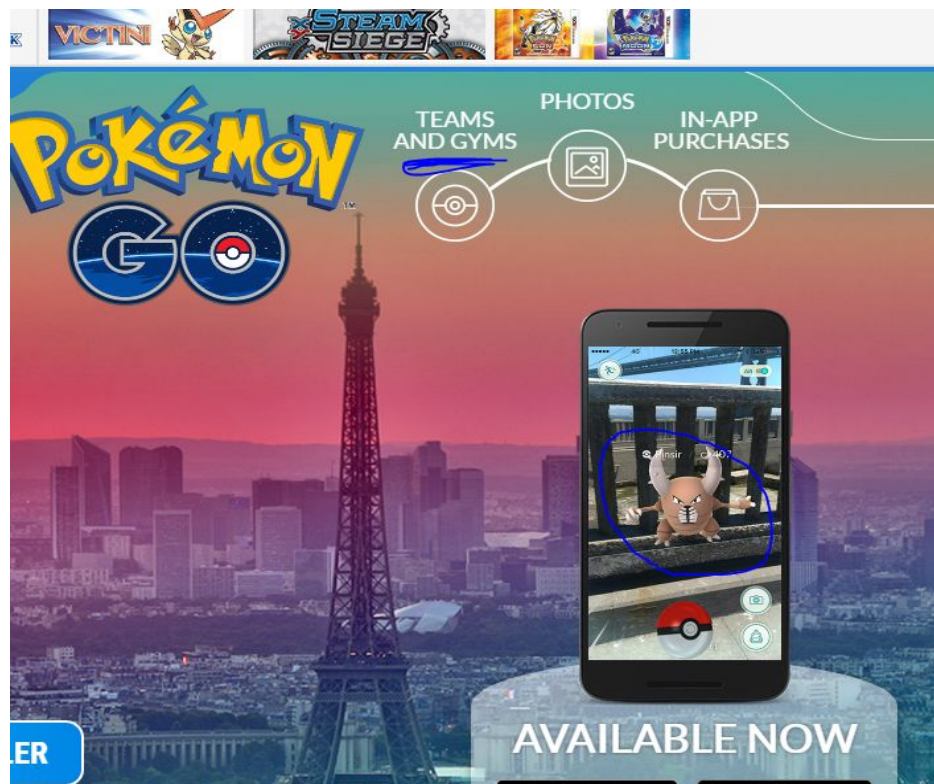Notice how a fiction character is being drawn on top of a real-life object.



Figure 5 (Pokemon Go)
From ("Catch Pokémon in the Real World with Pokémon GO!", 2016)

## 4.2 My Game Concept

A memory game based on cards where the exciting part relies on how fast the player connects english letters with cards that represent those letters (i.e: a picture of car is the letter 'A').

And in the same sense, the player may be given a set of cards that represent a word and voice recognition will be used to confirm player's answer.

Name of the game is still discussable but Brain Grinder suits the concept for now.



Letter A            Letter R            Letter C

Figure 6 (Game Cards Sample)

So, for example, if the player was asked to form the word "car", he/she will have to put the cards in order from left to right to achieve that goal.

And on the other hand, the game may show the cards that form word "car" and ask the player to pronounce it, so the gameplay can go either way.

## 4.3 Game Modes

- ***Solo*** : ( collect 100 stars to finish a difficulty level)
  - ❖ Frog (Easy)  : Player will be asked to form/pronounce words of 3 - 6 letters.
  - ❖ Ant (Medium) : Player will be asked to form/pronounce words of 6 letters minimum.
  - ❖ Pigeon (Hard): Player will be asked to form/pronounce sentences of 2 - 4 words.
  - ❖ Human (Intelligent): Player will be asked to form/pronounce sentences of 4 words minimum.

- *Head To Head* :
    - Form Cards :
        - \# Input : Maximum number of words Min (3).
        - \# Input : Maximum number of sentences (Min 0).
        - \# Input : Timer on/off.
        - \# Input : Difficulty (Frog - Human)

    - Pronounce Words :
        - \# Input : Maximum number of words Min (3).
        - \# Input : Maximum number of sentences (Min 0).
        - \# Input : Timer on/off.
        - \# Input : Difficulty (Frog - Human).

    - Feeling Intelligent :
        - \# Randomized set of challenges.
- *Group vs Group* : (May or may not be implemented depending on time)
    - Choose number of team members (Min 2).
    - Pick a number up (If Min then 1 or 2).
    - Randomized gameplay.
    - Every player will be given parts of the words/sentences to form/pronounce.

## 4.4 Game Rules & Elements
### Rules :
- For each correct answer the player wins 1 star, maximum of 3 stars can be won depending on how fast the player forms/pronounces the letter.
- Every 9 stars the player gets a "Hint" helper.
- If "Hint" is available, then it can be used by tapping on the card.
- Player has to organize the cards from left to right to represent the given word.
- Player has to pronounce the word represented by the cards correctly.
- A "Timer" will be used in Head To Head or Group gameplay.

### Elements :
- Physical Cards.
- English words.
- Voice recognition.
- Leaderboard.
- Timer.

# *Chapter 5*

**Implementation Plan**

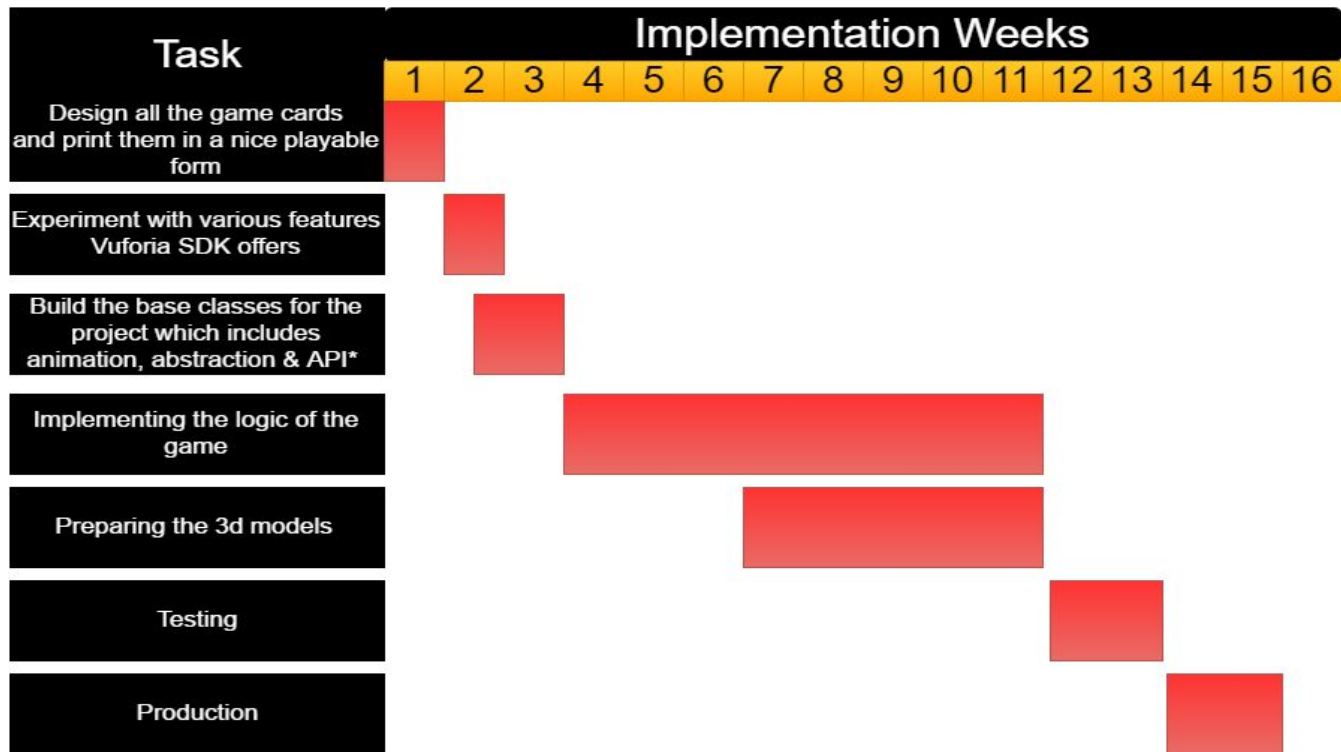| Task | Implementation Weeks | | | | | | | | | | | | | | | |
|------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Design all the game cards and print them in a nice playable form | ■ | | | | | | | | | | | | | | | |
| Experiment with various features Vuforia SDK offers | | ■ | | | | | | | | | | | | | | |
| Build the base classes for the project which includes animation, abstraction & API* | | | ■ | | | | | | | | | | | | | |
| Implementing the logic of the game | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |
| Preparing the 3d models | | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | |
| Testing | | | | | | | | | | | | ■ | ■ | | | |
| Production | | | | | | | | | | | | | | ■ | ■ | |

Figure 7 (Implementation Plan)

# *Chapter 6*

## Conclusion

A prototype has been built regarding this project to show the power of the technology with a consistent design that is going to be carried out from this first phase of the final year project to the next phase, all the possible analysis on the given title have been done and a fun and amusing game concept have been created after watching many game samples in the field.

In the end of the next phase of this project, the game concept created in this first phase will be used to create the game required to achieve the project's objectives. A fully playable game will be developed by the end of next trimester.

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